NUMBER 73 FEBRUARY 1944

THE BULLETIN

OF THE

U. S. Army Medical Department

A periodical containing original articles, reviews, news, and abstracts of interest to the Medical Department of the Army

ISSUED UNDER THE AUSPICES OF
THE OFFICE OF THE SURGEON GENERAL

PUBLISHED MONTHLY AT THE MEDICAL FIELD SERVICE SCHOOL,
CARLISLE BARRACKS, PENNSYLVANIA

By direction of the Secretary of War, the material contained herein is published as administrative information and is required for the proper transaction of the public business.

NORMAN T. KIRK
Major General, U. S. Army,
The Surgeon General.

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Foreword

With the October 1943 issue, The Bulletin became a monthly periodical, instead of a quarterly, dedicated to keeping the personnel of the Medical Department informed on developments in war medicine. The new publication, known as The Bulletin of the U. S. Army Medical Department, absorbed the former quarterly dental and veterinary bulletins and will have material devoted to those fields in each issue.

The Bulletin is intended to be educational rather than directive in nature. It will contain the best information obtainable concerning military medical experience, observations, and procedure that may help to improve further the quality of professional services. The Bulletin will be a medium whereby experience gained in one theater of combat may be shared with those serving in other combat areas and with those in this country who are preparing for overseas duty. News items concerning military and scientific developments as well as original articles will be emphasized. The Bulletin, however, should not serve as a basis for the forwarding of requisitions for equipment or supplies referred to therein.

Obviously, some of the most interesting field experiences cannot be divulged in a periodical of this kind when our country is at war. The Bulletin will, however, publish that which can be safely told, drawing not only on current literature, but on many authoritative reports which reach The Surgeon General's Office from the field. Officers are invited to submit for publication reports of their field experiences that can profitably be shared with other officers.

The Medical Department has been commended for its work in caring for the sick and wounded in theaters of operations in war. The Bulletin will endeavor to stimulate such progress and to advance further the high standard of medical service in the Army of the United States.

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Notice to Contributors

Contributions to the Bulletin should be typewritten, double spaced, with wide margins, and in duplicate including the original and one carbon copy. Great accuracy and completeness should be used in all reference to literature, including the name of the author, title of article, name of periodical, with volume, page, and number—day of month if weekly—and year. Materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized. Adequate legends should accompany each illustration in order to point out clearly to the reader the condition or lesion or other objectives, which in some instances should be indicated by a small arrow or other device. Each illustration and table should bear the author's name on the back; photographs should be clear and distinct; drawings should be made in black ink on white paper. Original articles will be accepted for publication on condition that they are contributed solely to The Bulletin and that editorial privilege is granted in preparing the material submitted for publication. Reprints may be ordered for official use only.

News and Comment

DELAYED CLOSURE OF WAR WOUNDS

The importance of leaving war wounds open following adequate débridement cannot be overemphasized. This is the most fundamental of all precepts of military surgery. One cannot hope to avoid dangerous and many times fatal infections if this principle is overlooked or forgotten. War wounds, therefore, no matter how innocent or innocuous they may appear following satisfactory débridement must be left open. Healing by secondary intention with a protracted convalescence and increased scar tissue formation is an inevitable consequence. To obviate the disadvantages incident to healing by secondary intention, observations on delayed wound closure are being made in the North African Theater of Operations. The results obtained justify a short discussion of the subject.

Bacteriological surveys of the wounds thus treated have not been made, but wounds are treated by appropriate local dressings until they are considered "clean" and free from clinical signs of infection. When the wound is considered "surgically safe for closure," one of several procedures may be employed to effect closure, the choice of which depends on the type of wound.

In the case of small wounds total excision is carried out and closure effected without drainage. Large deep wounds are cared for by simply freshening the skin edges of the wound and drawing the clean granulating surfaces and the freshly trimmed skin edges together by means of sutures of relatively large size spaced widely apart (about 1¼ inches). These sutures should be introduced about one inch from the wound edge on one side and carried through the depth of the wound to exit at a corresponding point on the opposite side. By introducing the sutures deeply in this manner the wound edges may be drawn together snugly with complete obliteration of the dead space. No attempt is made to obtain absolute approximation of the skin edges with these or supplementary sutures, as it is considered desirable to allow for the escape of serum

or exudate from the wound thereby minimizing danger of infection. These sutures should be allowed to remain in place for at least two weeks.

Superficial or shallow granulating wounds may be treated in one of two ways depending on the size of the area involved. If small, the skin edges about the defect can be freshened and undermined so as to permit their approximation by suture. If the defect is too large to permit this without causing undue tension on the skin, a half thickness graft should be applied to the granulating surface. A pressure dressing should be used in either case postoperatively to obliterate the dead space between the skin of half thickness graft and the underlying granulation tissue.

The results obtained in North Africa have varied with the type of the wound treated. In the case of the small wounds 100 percent successful closures have been reported. For the larger wounds and defects necessitating deep sutures, closures have been successful in 80 percent of the cases with a shortening of the total time required for healing in practically all cases. Complete takes of grafts have been accomplished in 84 percent, partial takes in 6 percent and failures in 10 percent of the cases in which this method has been employed. Although the place of delayed closure in the surgery of the present war has not been definitely determined as yet, its potentialities are great and justify a more widespread clinical trial.

COMPOUND FRACTURES AND WOUNDS OF EXTREMITIES

Confusion exists regarding proper emergency treatment of compound fractures. Some principles applied in civilian practice cannot safely be used in war surgery. This is particularly true of the closure of wounds. Serious infections and gas gangrene have resulted because surgeons thought they could safely close compound fractures. It is necessary to teach and to practice principles that are safe without too much reliance on individual judgment or on ideal circumstances. All war wounds and compound fractures of the extremities should be left open with suitable light packing. The Army does not subscribe to the policy that débridement is not essential. Careful débridement should be done as soon as the patient's condition

and the facilities permit. These principles apply at home as well as abroad.

Recent interrogation of a number of officers indicates some lack of knowledge of the principles involved. All emergency amputations for acute trauma and infection should be open (guillotine) amputations at the lowest possible level. All officers are responsible for familiarity with S.G.O. Circular Letters No. 91, subject, "Amputations," 26 April 1943, and No. 178, subject, "Care of the wounded in theaters of operation," 23 October 1943.

Internal metallic fixation is a valuable procedure in definitive fracture treatment. However, its application in compound fractures both in the United States and overseas has been followed in some cases by chronic osteomyelitis and nonunion. Examination of many compound war fractures treated by plating and others treated by careful débridement followed by cast or splinting, with skin or skeletal traction as necessary, indicates that the latter conservative principles yield better results. The nature of the injuries and the variable circumstances of treatment and evacuation involved in the Army are not favorable for initial extensive surgical treatment of the fractures. The use of skeletal fixation by multiple pins fixed by plaster or mechanical means has likewise resulted in bone infection in the pin wounds. The use of pins in the vicinity of traumatic or operative wounds is especially discouraged.

Where internal fixation is indicated in simple fractures, it should be secured by strong inert material adequate in size and extent for the particular case. Many cases which have had successful surgery have failed to unite because (1) the fixation medium has broken or become loose; (2) the bone has been fixed in distraction or without complete reduction; (3) external immobilization has been discontinued before union occurred. These errors deserve careful emphasis.

Summary

1. Do not close compound fractures and wounds of the extremities.

2. Do emergency amputations by open (guillotine) method at lowest possible level.

3. Do not plate compound fracture if it can be avoided.

4. Do a good reduction and impaction when plating a fracture, fix it well, and protect it until united.

DENTAL LANTERN SLIDES FOR LOAN

Any Army hospital, camp, station, or post may secure Kodachrome lantern slides, size 2 by 2-inches, on loan through the facilities of the Registry of Dental and Oral Pathology by writing the Curator, Army Medical Museum, 7th Street and Independence Ave., SW., Washington 25, D. C. The slides have been arranged in sets appropriate for lectures, and the following subjects are covered: mouth diseases, diseases of the tongue, tumors, periodontia, caries, and dental lesions. The request should specify the title of the material intended for the lecture.

One of the important functions of the Oral Pathology Registry at the Army Medical Museum is its teaching program. Two editions of an Atlas of Dental and Oral Pathology have been published, and now loan sets of slides with a descriptive syllabus are available for study of histopathology. The atlas and the loan sets have been in demand by officers of both the Dental and Medical Corps.

The library consists of about 1,000 2 by 2-inch slides which deal with dental and oral diseases. The slides show the clinical and microscopic aspects, giving the dentist or physician a chance to correlate the clinical and pathologic manifestations.

REPLACEMENT OF SUBSTANDARD SURGICAL INSTRUMENTS

Now that delivery needs of most Class 3 surgical instruments have been met and adequate stocks exist of virtually all items, the Army Medical Purchasing Office is engaged in a program for the withdrawal and replacement of substandard surgical instruments from all Medical Department stocks. When this program was inaugurated, there were many instruments in the field and in depot stocks which were purchased during World War I. All of these instruments are nickel-plated; consequently, they do not stand up under atmospheric conditions nor withstand sterilization as well as chromium-plated or corrosion-resistant steel instruments. Many of the patterns are obsolete and the quality in most cases is far below the quality of those purchased today. This is especially true of the Japanese instruments still to be found in some depots. It was decided to set these instruments aside if sufficient quantities of high quality instruments were available.

Inspection officers from the Army Medical Purchasing Office are visiting all depots, classifying instruments into four

categories: (1) unserviceable and unrepairable, (2) stubstandard to be repaired, (3) substandard to be held in suspended stock until replacements are available, and (4) serviceable.

The unserviceable and unrepairable instruments are to be sent to the St. Louis Medical Depot until final disposition is determined. Substandard instruments that can be repaired or reworked will, in most cases, be returned to the manufacturer. This category includes instruments supplied by newcomers in the surgical instrument field, whose first instruments were accepted as serviceable because of the extreme urgency. although they were acknowledged to be of substandard quality. Instruments to be held in suspended stock are those of substandard quality which should be replaced or repaired, but may be required before replacements are available.

When all depot stocks of Class 3 items have been classified, it is intended to replace substandard instruments in the hospitals throughout the United States; later, Medical Department installations outside the country may be treated similarly. It is also planned to establish a program for the passivation of all box lock corrosion-resistant steel instruments in depot stocks and the treatment of all surgical instruments with a rust preventive. The purpose of passivating box lock instruments is to prevent corrosion and the resultant freezing of the locks.

The Army Medical Purchasing Office is of the opinion that, at the conclusion of this program, all surgical instruments remaining in use and in the Medical Department stock will be of the highest quality, and those not required immediately will be properly preserved for any future emergency.

ARCH SUPPORTS

The Surgeon General has authorized three special types of rubber insert arch supports for ultimate issuance to all military personnel requiring foot correction. It is contemplated that the first production of these supports will be available to combat zone hospitals in theaters of operations, but as the supply is expanded they will be provided to all posts, camps, and stations in this country as well. These items are being included in the Medical Department Supply Catalog through Change Sheets No. 1. Procurement is already under way and initial supplies will be available for distribution in accordance with S.G.O. Circular Letter No. 154, dated 30 August 1943.

These supports are to be provided in varying standard sizes for metatarsal support, plantar support, and combined metatarsal and plantar supports. The productive capacity of one manufacturer has already been contracted for and The Surgeon General's Office is making arrangements to complete its requirements through production at the plants of one or more additional manufacturers. When these companies get under way on full production, it is expected that all Army requirements can be met. It is contemplated that this will be achieved sometime between now and 1 June 1944.

Meanwhile, a program to achieve foot corrections in eighty-six zone of the interior installations is already progressing on a restricted scale. These installations were authorized some time ago to install an apparatus for making arch supports to conform to the shape of the foot. Other posts, camps, and stations were authorized by W.D. Circular No. 152, section IV, dated 3 July 1943, to secure minor orthopedic adjustments and repairs for qualified personnel from local civilian shoe shops, if such service is not available through quartermaster repair shops. On the same date, AR 40-505 (C-4) authorized general and station hospitals to procure minor orthopedic shoe adjustments, including removable, commercial, and specially made arch supports at reasonable cost without the necessity of securing prior approval from higher authority. The foot correction program as now constituted is expected to be adequate to meet present and contemplated requirements.

NATURAL INFECTIONS AND THERAPEUTICALLY INDUCED MALARIA

Therapeutic malaria has been induced by several methods, of which those commonly used are the bites of infected anopheline mosquitoes and the inoculation of blood from a patient harboring malarial parasites. In the United States the second method has been used by most of the institutions which give this treatment, while mosquito transmission has been employed exceptionally for experimental purposes. *P. vivax* has been the species commonly injected, although there has been an increasing employment of *P. malariae*, especially in groups in which there is a significant degree of immunity to *P. vivax*. In general, the strains used for fever therapy have been passed from patient to patient for long periods without going through the sexual phase of their life cycle in the mosquito.

The differences between vivax and malariae malaria which

is inoculated by blood injection and that which is mosquito-borne, whether naturally or artifically acquired, are considerable. In the first case, trophozoites, and in some instances gametocytes, are introduced but not sporozoites; whereas, the mosquito injects sporozoites alone. Apparently because of this biological difference, the clinical behavior of malaria differs much in the two cases. After the amounts of blood commonly given, the incubation period of trophozoite-induced malaria is sometimes as short as three days as compared with 10 to 14 days for mosquito-borne malaria. Indeed, it is possible almost to do away with the incubation period by injecting sufficiently large numbers of parasites. The onset of an attack of trophozoite-induced vivax or malariae malaria is apt to be slow, with the temperature rising irregularly over a period of 48 to 72 hours; following this, chills and temperature spikes often occur daily for several days. The symptoms are the same as those seen in natural infections but are generally milder. A dose of neoarsphenamine or mapharsen within a few days of trophozoite inoculation may prevent the appearance of a clinical attack, and a single dose during the clinical attack may stop it for good, although attacks of naturally acquired malaria are known to occur in patients while they are under arsenical treatment for syphilis. Five or ten grains of quinine may stop a clinical attack of trophozoite-induced malaria; small doses of atabrine are similarly effective. Most remarkable is the action of thiobismol (sodium bismuth thioglycollate), of which 0.1 gm. often suffices to end an attack.

The most striking quality of trophozoite-induced vivax or malariae malaria is the rarity of relapses, which is so great that their occurrence may be questioned (bearing in mind the possibility of reinfection which must be excluded). It is true that many patients given malarial fever therapy receive prolonged antisyphilitic therapy thereafter, which might suppress malarial activity. This is not true, however, of all such patients. It seems unlikely that such treatment is curative of malaria, but that the prevalent failure of blood-induced malaria to relapse is related to the fact that its cycle begins with trophozoites.

The known differences between trophozoite-induced and sporozoite-induced malaria are such that results of treatment in the first instance cannot safely be transferred to the naturally acquired disease. All tests of treatment finally have to be made in mosquito-transmitted malaria.

ANIMALS IN COMBAT

Horses and mules have proved to be of great value to the American Fifth Army during recent fighting over mountainous terrain in Italy. All horses and mules available locally have been procured and pressed into service with reconnaissance units and as pack animals, to furnish troops at the front with food, guns, ammunition, and clothing. Likewise in the Southwest Pacific Area, horses and mules are playing a vital part in enabling field artillery and quartermaster units to make advances through otherwise impassable country.

SCABIES

Scabies has swept over armies in great epidemics in the past, but has decreased with improved sanitation and personal hygiene. It is reported that in World War I, in the nine months ending with 31 December 1919, a total of 394,449 days was lost by United States troops because of scabies. The Department of Military Sanitation, Medical Field Service School, Carlisle Barracks, Pennsylvania, points out that the intense itching which characterizes scabies usually begins about ten days after infection. The itching is due more particularly to the irritating secretions of the mite than to the mechanical irritation caused by the burrowing. The burrows occur usually between the fingers and toes, on the hands and wrists, about the groin and genitalia, and behind the knees. Hard tiny vesicles containing a yellowish fluid are formed along the course of the burrows. Since the mites breed in the skin, the infection frequently persists; sometimes it is called "seven-year itch." The infection may recede in the winter, but it spreads with the coming of spring unless treated. The mites, though not in the vesicles, may be found nearby in the burrows. The adult female measures 0.30 by 0.40 mm.; the male 0.15 by 0.25 mm.

Infections result from the transfer of male and female mites from an infected individual to another by direct contact or less frequently by contact with infested underwear, bedding, or towels. As the female burrows into the skin of a person, she deposits 10-25 eggs and excrement along the tortuous tunnel over a period of three to five weeks and then dies. The eggs hatch in three to six days into larvae which resemble the adults except for the absence of the fourth pair of legs. The larvae molt in two or three days, giving rise to the nymphal

stage. The nymphs tunnel their own burrows and become mature in four to six days when egg-laying begins. The entire life cycle requires from nine to sixteen days.

Diagnosis

Early diagnosis is important. A very close skin inspection is necessary with the man completely stripped. A cursory examination such as is made at the monthly physical inspections is inadequate. After careful examination of the front of the body and the hands, the man should kneel on a box so that his buttocks, elbows, and feet can be examined. A few burrows can be found before the typical dermatitis with excoriations appears.

To extract mites for microscopic examination, first find the distal end of a mite burrow; here there is a slight expansion of the burrow and in it is the highly refractile and opalescent body of the parasite, visible to the naked eye as a white speck. The thin roof of the burrow over the mite should be lifted with a needle which is withdrawn and reinserted gently until the mite sticks to it and can be transferred to a warm slide for examination under a low-powered microscope.

Control

The infested individual should be segregated in accordance with AR 40-210, dated 15 September 1942, sec. VIII, par. 36 (see also AR 40-205). This should be interpreted to mean hospitalization until medical treatment (sulphur, beta-naphthol, pyrethrum, or rotenone ointments) accomplishes his complete disinfestation. All men who have been in daily contact with an infected individual should be thoroughly examined. Underclothing coming in contact with infested parts should be boiled, steam-sterilized, or baked; clothing, bedding, socks, gloves, and shoes should be disinfested in the same manner as for body lice. Prevention consists in the avoidance of contact with infested individuals, bed linen, or public towels.*

*Since 1936, for reasons as yet unknown, scabies (in England) has been steadily increasing and since the beginning of the present war has again become very prevalent. . . . It was formerly believed that scabies was very likely to be transmitted when an infected person shared clothing, bedding, or towels with someone else. Recent experiments carried out on volunteers, however, show that this method of spread is uncommon. Direct contact appears to be the method by which the vast majority of sufferers are infected. A common sequence observed in England is that a soldier on leave contracts scabies from his wife, who in turn has caught it from the children; the latter communicate it to one another during play.

It is also possible that transmission can occur through contact with animals. Buxton has stated: The disease is an occupational one amongst those whose pleasure or profession it is to breed dogs, nurse cats, milk cows, groom horses, tame lions, box with kangaroos or tend llamas. (Compilation of War Medicine and Surgery under the direction of the Committee on the Survey of War Medicine of the National Health and Medical Research Council, published in the supplement to the Medical Journal of Australia of 24 July 1943)

RECONSTITUTED MILK

Recent surveys of Army milk supplies show that in some areas fluid milk shortages are being satisfactorily met by supplementing the local supply with reconstituted milk. The following types of reconstituted milk are being used for this purpose: Type I, pasteurized reconstituted milk prepared from condensed skim milk and fresh pasteurized cream; Type II, pasteurized blended milk which consists of a blend of fresh fluid milk and reconstituted milk; and Type III, pasteurized milk, standardized with reconstituted skim milk and prepared by using condensed skim milk and fresh fluid milk. In a few localities the use of Type III reconstituted milk is quite general and if the milk shortage becomes more acute in these localities the use of larger quantities of Type I and Type II will probably become necessary to maintain the supply at its present level. The reconstituted milk is processed and bottled in the same manner as fresh fluid milk. It is generally of good quality and its palatability comparable to that of Grade A milk.

The use of reconstituted milk prepared from bulk condensed milk is, however, presenting problems to the Medical Department of the Army. Condensed milk is not a sterile product, and it is as subject to contamination as fresh milk. Furthermore the lactic acid organisms are largely destroyed during processing with the result that the condensed milk does not readily sour, thus eliminating a common and well-recognized indicator of the age and quality of the milk. Proteolytic organisms, however, which may be present in the condensed milk are capable of multiplying therein and causing decomposition. Therefore, in order to insure safety, bulk condensed milk, when used in the preparation of reconstituted milk for beverage purposes, must conform to definite specifications, be used within a definite time limit after condensing, be obtained only from approved sources and be handled in a sanitary manner at all times. In some sections a large percentage of the plants furnishing reconstituted milk to the Army are a combination milk plant and ice-cream plant. Condensed milk is used extensively in the manufacture of ice cream and it is customary for plants to keep a supply in storage. No evidence has been found that such condensed milk is being substituted for that from approved sources in the preparation of recon-

stituted milk for the Army. It could, of course, be done by an unscrupulous dealer if his plant is not under close observation.

It is more difficult to determine whether or not specification requirements are met when reconstituted milk is used than it is when fresh pasteurized milk is used. There are no tests which can be applied to the milk as delivered that will differentiate between the types of reconstituted milk or between reconstituted milk and fresh pasteurized milk. The only method of ascertaining that the reconstituted milk delivered conforms to the type specified in the contract is to see the product prepared in the plant. The necessity of doing this is brought out in one locality where five plants have contracts to furnish milk to the Army. The contracts permit these plants to furnish Type III reconstituted milk. It was found that one plant was furnishing Type III; one, Type II; and three plants, Type I reconstituted milk. Under such conditions, in order to assure delivery to the Army of a reconstituted milk that is safe, of good quality and which conforms to specifications, it is necessary to establish point of origin inspection in plants processing this product. Point of origin inspection is the only method of assuring that: (1) the bulk condensed milk as delivered to the plants meets specifications; (2) that it is used within the time limit; (3) that it is handled in a sanitary manner; (4) that no substitutions are made; and (5) that the type of reconstituted milk called for in the contract is properly prepared and handled.

There appears to be a tendency on the part of the contracting parties to prefer the use of Type I reconstituted milk; however, the Medical Department is discouraging, as far as practicable, the use of this type of reconstituted milk. The heat treatment received during the preparation of the condensed skim milk and the use of fresh pasteurized cream, render valueless the phosphatase test for proper pasteurization of the reconstituted milk. Fresh fluid milk being a component part thereof, the phosphatase test is applicable to Type II and Type III reconstituted milk. Proper pasteurization is absolutely essential to a safe milk supply. Every available means must be used to assure that all milk delivered to the Army is properly pasteurized.

INSPECTION OF MEAT AND DAIRY PRODUCTS

The Veterinary Corps is inspecting over one-half billion pounds of meat, meat-food, and dairy products each month in the United States for the Army and such of these items as are purchased by the Quartermaster Market Centers for the Navy, Marine Corps, and other agencies.

The extent of milk inspection by the Veterinary Corps is indicated by the fact that the quantities procured for the Army in the United States are such that during the past year each soldier was provided with an average of one-half pint of fresh or reconstituted milk per day.

ENCEPHALITIS IN MAN DUE TO VENEZUELAN VIRUS OF EQUINE ENCEPHALOMYELITIS

Of three immunologically different strains of equine encephalomyelitis viruses known to be present in the Western Hemisphere, fatal human cases due to the eastern-type virus were established by Fothergill, Dingle, Faber, and Connerly, of Harvard University in 1938; later in the same year, Miss Howitt, of the Hooper Foundation, San Francisco, reported the isolation of the western-type virus from a fatal human case.

Although Venezuelan-type equine encephalomyelitis in man may have been suspected, only two cases have been reported. These two very mild cases occurred in the United States in laboratory personnel working with the virus.

During the latter part of the summer and fall of 1943 about 70 cases of fatal encephalitis occurred among horses and mules in Trinidad, British West Indies. The epizootic was tentatively diagnosed by the local authorities from the clinical symptoms as the virus type of equine encephalomyelitis. This was subsequently confirmed by specimens sent to the Army Veterinary School, Medical Department Professional Service Schools, Army Medical Center, Washington, D. C. Subsequently a specimen of brain tissue from a human case of encephalitis that had died on 22 August 1943 was received. The inoculation of mice and guinea pigs with this brain material resulted in the recovery of the virus of equine encephalomyelitis and cross immunity tests demonstrated it to be of the Venezuelan type.

This is the first instance in which the Venezuelan strain of equine encephalomyelitis virus has been proved to occur naturally in man, producing a fatal infection. Further, it establishes the fact that all three strains of equine encephalomyelitis viruses

known to be present in the Western Hemisphere are capable of producing a fatal encephalitis in man. From information available, this appears to be the first outbreak of equine encephalomyelitis in Trinidad, and it was caused by the Venezuelan type of virus.

QUININE IN PLASMA FOR INTRAVENOUS INJECTION

The intravenous use of quinine is often considered dangerous because a shock-like state occasionally ensues. However, in certain cases, which are mostly falciparum infections, this measure is essential to save life. Experience shows that circulatory collapse rarely results if the speed of injection is slow and the concentration of quinine is low. A medical officer recently suggested a possible further safeguard. He found that the fall in blood pressure was less and the results in general were better when quinine was given intravenously in blood plasma, rather than in saline solution. Since many of the patients who need this treatment may also benefit from plasma, this method merits further trial. The speed of injection should still be slow.

CONSERVATION OF DENTAL BURS

Because of the great amount of dental treatment that is being provided, requirements for dental burs are considerably in excess of production capabilities. It is, therefore, requested that the following instructions be carefully observed:

1. Dental burs will be cleaned, sterilized, and dried each time they are used.

2. Only a sufficient supply to meet current monthly needs will be maintained in dental clinics. Quantities in excess of monthly needs will be returned to the local medical supply officer for future issue.

3. Burs which have become unserviceable will be carefully cleaned and dried, placed in original packages or in envelopes labeled according to size, and turned in to the local medical supply officer for sharpening.

4. Burs returned for sharpening will be carefully sorted, and the ones which are broken or rusted to the extent that sharpening seems impracticable will be discarded.

At present, distribution depots are having burs sharpened when sufficient numbers are turned in from posts, camps, and stations. The entire bur sharpening facilities of the nation are being fully studied in an attempt to determine the best methods to be employed. Further information will be published later.

PRECAUTIONS TO ASSURE THAT ANTIMALARIAL MEDICATION IS TAKEN

Reports from installations at home and overseas emphasize the need for medical officers to assure themselves that individuals actually take each ordered dose of any antimalarial drug, whether for suppressive or for clinical treatment. If precautions are inadequate, ordered doses are frequently evaded. The reports in question refer to the finding of accumulations of tablets in and around latrines, just inside messhall doors, and under mattresses. In some cases the checking of atabrine plasma levels has led to the discovery of evasions. It seems probable that many instances of so-called break-through of clinical symptoms during suppressive treatment are due to failure to keep up ordered medication. In the case of clinical attacks, such omission of medication might be very dangerous. Studies of the correlation of dosage and the efficacy of treatment are worthless unless all of the drug ordered is taken.

BOARD TO DIRECT STUDIES IN MALARIA TREATMENT

The Surgeon General has appointed a board of five officers which will direct the Medical Department's studies in the treatment of malaria in four selected general hospitals—the Percy Jones, Kennedy, Harmon, and Bushnell General Hospitals.[1]

Plans of therapy which experience has shown to merit further study and new methods of treatment which have passed adequate preliminary trials elsewhere will be tested in order to decide what is the best available procedure. Clinical studies and special laboratory examinations will be made. Provision has been made for follow-up of patients for at least six months. In planning these studies and in evaluating their results, the board will have the collaboration of a special committee of the National Research Council.

As a part of the program for the stabilization of malaria treatment, all medical installations in continental United States have been requested to adhere to the plans of therapy described in S. G. O. Circular Letter No. 153, 19 August 1943, except such as have The Surgeon General's approval for use of other plans.

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1. The members of this board are Major General Shelley U. Marietta, U.S.A., chairman, Colonel George R. Callender, M.C., Lieut. Colonel Thomas T. MacKie, M.C., Lieut. Colonel Francis R. Dieuaide, M.C., and Major O. R. McCoy, M.C.

THE PHOSPHATASE TEST FOR PASTEURIZED MILK

Before the development of the phosphatase test, there was no accurate method for determining whether milk had been properly pasteurized or whether or not pasteurized milk contained raw milk. Now it is possible for a control laboratory or an inspector to determine that milk has been properly pasteurized.

The importance of the test as applied to milk for the Army cannot be overemphasized. The facts that practically every pasteurizing plant in the country is operating in excess of capacity and that they have lost many of their trained personnel have increased the possibility of improper pasteurization.

Any station veterinarian who does not have a phosphatase-test kit (Item Number 43552, Milk Testing Apparatus, Pasteurization, Phosphatase Type; and Item Number 43554, Milk Testing Apparatus, Pasteurization, Phosphatase Type, Tablets For—Medical Department Supply Catalog) should obtain one and assure himself that the test is applied to all milk delivered to Army installations.

The phosphatase test, which is based on the inactivation of the enzyme phosphatase in milk during pasteurization, is widely used by health departments and control laboratories. The "field test" is nearly as effective as any of the laboratory tests and its simplicity and rapidity adapt it to the control of Army milk supplies. Although this test is relatively simple, the operator should be thoroughly familiar with the method by making tests on boiled milk and the same milk containing 0.1, 0.2, 0.5, and 1.0 percent added raw milk. Experience will enable one to detect even minor errors in pasteurization. After becoming familiar with the test he should repeat the above procedure at regular intervals as a check on his technique and on the reagents he is using.

In spite of its simplicity, the phosphatase test is a precision test. It, therefore, must be carefully conducted, for carelessness means failure to detect improperly pasteurized milk. To obtain reliable results the directions for conducting the test must be followed closely and all the precautions regarding glassware and reagents closely observed.

The reagents for conducting the test are obtainable in tablet form. The tablets for the preparation of the substrate (white tablets under Item Number 43554) may develop small amounts of phenol on exposure to heat, sunlight, or moisture and they should be kept under refrigeration. The substrate solution being

less stable than the tablets, the solution should be prepared only shortly before use. The BQC reagent (2, 6-dibromoquinonechloroimide) is more stable than the substrate solution and, while advisable to keep the solution under refrigeration, it has been considered relatively stable in tablet form and little attention has been given to the care of the tablets. There have been instances recently where the BQC tablets (yellow tablets under Item Number 43554) have deteriorated to such an extent that acurate results were not obtained. Conducting the test on boiled milk to which definite quantities of raw milk have been added will show whether or not the tablets have deteriorated. These tablets may also be tested as follows:

> Conduct the test according to directions with the exception that 0.5 ml. of phenol solution (5 parts per million phenol in distilled water) is substituted for the 0.5 ml. of milk. If the BQC reagent has not deteriorated, the test conducted in this manner will give the border-line blue color. A more severe test would be the use of phenol solution containing 10 parts per million phenol. If the latter fails to give a definite blue color, the solution should be discarded.
>
> Under present conditions each time the BQC reagent is prepared its strength should be tested to assure that it has not been prepared from a tablet which has deteriorated. Solutions which have been held for some time can be tested in the same manner. As the phenol solution is relatively stable if kept tightly stoppered, it need not be prepared more frequently than once a month.

MEETING AT WALTER REED GENERAL HOSPITAL

The Army Air Forces provided the program for the monthly meeting for officers of the Medical Department residing in the District of Columbia and vicinity at the Army Medical Center, 20 December 1943. Major General Norman T. Kirk, The Surgeon General, opened the meeting, introducing Major General David N. W. Grant, The Air Surgeon, who introduced the following speakers: Lieut. Colonel Richard L. Meiling, M.C., whose subject was "Air Evacuations," Detlev W. Bronk, M. D., Consultant to the Air Surgeon, "The Role of the Sciences in Aviation Medicine," and Major Herman S. Wigodsky, M. D., "The Army Air Force Altitude Training Program." Following the addresses the sound and color film, "Oxygen in Aviation," was presented.

Correspondence

THANKS FROM A BRITISH SOLDIER

8 November 1943.

Dear Mr. President:

I, a British Tommy, have taken the great liberty of writing to you to express my heartfelt thanks to the doctors and nurses of a station hospital, U. S. A., somewhere in North Africa, who through their skill and patience made it possible for me to be a fit man once more. Especially to the major and the lieutenant whom I can never thank enough for what they did for me, and to the nurse of ward 27 whom I knew only as Miss Connie. Nothing was ever too much trouble for her to make our pain and wounds easier to bear.

The treatment received during the six weeks' stay in this hospital will live forever in my memory. There is one British soldier who really means, "God Bless America."

I should be very grateful if you could convey my heartfelt thanks to the medical staff of this hospital.

Sincerely yours,

Private ——— ———

MEDICAL SERVICE IN SOUTH PACIFIC AREA

First Lieutenant Theodore C. Wedel, the only one of four men who escaped death in a foxhole bombed in the South Pacific area, has recovered from injuries and is back on duty with his regiment. In a letter to his father, published in the Washington Evening Star, Lieutenant Wedel said in part:

"We had been fighting through jungle for days, never able to see more than 10 feet ahead. Finally we captured a ridge from which we could see a shell-torn plain stretching to the airport which was our objective. The end of the battle was near. Strangely, I never was as afraid as I thought I'd be. I had the attitude if they hit me, they hit me. The medical care on the battlefield and in the field and base hospitals is magnificent. Everything that medical science knows is done to save lives and ease pain. That should be a great comfort to you at home."

Special Articles

Gas Gangrene

In the last war the incidence of gas gangrene in our battle wounds was 1.7 percent. Although in the early part of the war this figure was much higher, later with the increased performance of early and thorough débridement and insistence on leaving all war wounds open it rapidly dropped. Similar observations are being made in this war and all reports from combat areas show that until surgeons learn by bitter experience the importance of these two principles the occurrence of gas gangrene remains unjustifiably high. Indeed the general incidence of gas gangrene thus far in this war closely approximates that of the last war. On the basis of extensive studies on anaerobic infections of war wounds in the Middle East among the British troops, MacLennan found that "neither in prevention nor treatment has much advance been made in the last 25 years" despite the fact that in this period "the potency of antisera has at least been doubled and the whole group of sulphonamide drugs introduced." Similarly the incidence and mortality of gas gangrene among our wounded have been in accord with these findings. These startling observations emphasize the importance of this problem especially in view of the increased possibilities of anaerobic infection as fighting on the highly fertilized soil of the European Continent progresses.

PREDISPOSING FACTORS

Since the mortality (40 to 50 percent) and the morbidity in established gas gangrene are so high, the prevention of this complication is of the greatest importance. In order to do this effectively consideration must be given to the causation of the disease and the factors which predispose to its development. These consist essentially in the presence of anaerobic spore-bearing bacilli of the *Clostridium* group and of devitalized tissue. The most important organisms are *Cl. welchii, Cl. oedematiens,* and *Cl. septicum,* all of which liberate a toxin having necro-

Prepared in the Office of The Surgeon General.

tizing and hemolytic properties in varying potency. Because of the ubiquity of anaerobic bacteria their presence in wounds, especially battle wounds, is highly probable. However, the clinical condition of gas gangrene develops in only a certain number of these wounds. While the summation of conditions in a wound that result on the one hand in local infestation and on the other in spreading gas gangrene is not completely understood, certain factors which favor the growth of *Clostridia* and enhance the development of the infection have been established. Of these the most important is impairment or loss of circulation in the involved tissues. This may be produced directly by the traumatizing agent or the injurious action of bacterial toxins and proteolysis, or indirectly by remote interference with the blood supply. This latter category is particularly important because it represents too frequently the consequences of certain hastily applied emergency measures having highly jeopardous potentialities. Included in this category are tight bandages, tightly packed wounds, tourniquets, and plaster of paris casts, all of which by their compressive or constrictive action can when applied for prolonged periods interfere with the circulation of the affected part. *Plaster of paris casts are particularly dangerous when applied under conditions which do not permit close observation of the patient afterwards and when the cast has not been bivalved to allow for subsequent swelling of the tissues.* Other factors which impair or interfere with the circulation of the affected part are direct injury to the main arterial blood supply and traumatic or segmental vasospasm. In addition to these factors which endanger the local vascularity of the already damaged tissues consideration must be given to certain types of wounds in which gas gangrene is particularly liable to develop. These include wounds in which there has been extensive laceration of muscles, compound fractures of long bones, penetrating wounds of the abdomen and perineum, wounds obviously contaminated with soil, dust, or debris, and wounds in which foreign bodies and fragments of clothing have penetrated deeply into the tissues. Of particular importance are injuries involving certain groups of muscles in the buttocks and lower extremity such as the gluteus maximus, the hamstrings, rectus femoris, vastus intermedius, and the gastrocnemius. Because in these muscles the blood supply is derived from only one or two sources which if cut off may result in ischemia of the entire muscles, wounds in these regions may be more frequently associated with gas

bacillus infection. Certain conditions such as severe hemorrhage and shock with resultant anemia, prolonged exposure with exhaustion, and difficulties in evacuation which delay surgical treatment also increase the liability of the development of gas gangrene. Finally, it should be emphasized that *primary closure* of battle wounds contributes to the development of gas gangrene.

PROPHYLAXIS

Effective prophylaxis of gas gangrene depends on an adequate realization of the factors and conditions under which the disease is particularly liable to develop. This permits the institution of measures directed at their prevention. It is essential, however, that this be done as soon as possible after the injury has been received. Since the underlying factor contributing to the development of this grave infection is loss or impairment of the local circulation, preventive measures should be designed toward the removal of all tissue in which the circulation is lost or dangerously impaired and the avoidance of procedures that jeopardize the vascularity of the affected part. This is best accomplished by close adherence to certain fundamental principles in the care of wounds. Of these the most important is early and adequate débridement. This includes sufficient exposure to permit ready access to all parts of the wound and the removal of all contaminated and devitalized tissue and foreign bodies. Because of its great vulnerability special attention should be given to muscle tissue which is altered in appearance and color and which has lost its ability to contract and to bleed. The presence of this triad, long recognized as evidence of muscle devitalization, demands wide excision. Of particular importance in this connection is involvement of certain muscles of the buttocks and lower extremity indicated above. Careful attention should also be given to the excision of bruised tags of fascia and to the removal of blood clots, completely detached fragments of bone, and foreign bodies such as bits of clothing and fragments of high explosive bombs and shells. While it is important to remove all contaminated and damaged tissue, the unnecessary sacrificing of healthy tissue should be avoided and considerable care should be exercised in preserving the integrity of major blood vessels and nerves. A skillfully performed débridement leaves a clean healthy wound provided with adequate drainage. Following com-

pletion of this procedure the wound may be lightly dusted with sulfanilamide crystals, vaseline gauze should be loosely placed over the wound surface, and the part should be adequately immobilized by splinting. Although it has not been definitely established clinically that the local use of sulfonamides prevents the development of gas gangrene, there is some experimental evidence to indicate its usefulness. It should always be supplemented by oral administration of the drug. The tight packing of wounds and the application of tight bandages should always be avoided and immediate splinting of the part should be effected by means other than plaster of paris casts. Traumatic or segmental vasospasm should be combatted by repeated novocain block of the regional sympathetics. Patients with evidence of injury to the main arterial blood supply and with wounds or injuries that are particularly liable to develop gas gangrene demand close observation. For this reason they should be evacuated as soon as possible after injury to installations with facilities for the proper surgical care described above. Because careful observation of the wound is essential, this type of case should not be moved from these installations and should not have plaster of paris cast applied until the danger of gas gangrene is past. The prophylactic value of polyvalent gas gangrene antitoxin has not been established clinically and its use for this purpose is not recommended.

TREATMENT

The treatment of established gas gangrene is directed toward controlling the infection and combatting the toxemia. This is best accomplished by the combined use of surgery, antitoxin, sulfonamides, and supportive measures. Early institution of therapy is absolutely essential, for once the disease is manifest its progress is extremely rapid. For this reason and in order to permit early diagnosis the premonitory symptoms and signs should be recognized. The most effective measure in the treatment of established gas gangrene is the removal of all involved tissue. Depending on the degree of involvement, this may be accomplished by excision only of muscles or groups of muscles or it may necessitate the more radical procedure of amputation. It is important in this connection to distinguish between true gas gangrene and "anaerobic cellulitis." The latter is a more circumscribed type of infection involving superficial connective tis-

sues rather than muscle and associated with little systemic disturbances. Free incision with removal of locally infected tissues is usually sufficient in "anaerobic cellulitis" and the radical excision of gangrenous and infected muscle tissue, which is essential in true gas gangrene, is rarely necessary. In an effort to neutralize the toxin, polyvalent gas gangrene antitoxin should be administered, preferably intravenously, after suitable precautions against anaphylactic shock have been taken. A minimum dose of three ampoules repeated hourly at the discretion of the medical officer until six doses have been administered is recommended. Chemotherapy should be maintained. In gas bacillus infection there is rapid and profound destruction of erythrocytes due to the liberation of potent hemolytic toxins; whole blood transfusion therefore should be employed.

Social Readjustment in War.—Another important aspect of the social readjustment in war is the sudden change in prestige and power of many men. Often as the result of haphazard events people become national heroes or objects of general abhorrence. The humble shoemaker becomes superior to the officious proprietor; the elevator boy, now a flight corporal, dictates orders to the businessman who once discharged him. One never knows who is inside a uniform, nor can one predict how he will behave. All one knows is that he has more or less commanding power. People must be judged by their appearance, and not by their personal value. This peculiar dissociation of being and appearance increases the difficulty of psychological adjustment in wartime.

Nevertheless, the average man possesses an incredible mental plasticity and can overcome all these obstacles provided that he becomes absolutely convinced of the necessity to do so. To obtain this conviction is not easy. If dull, a man may not understand the "whys" of such demands upon him; if bright, he may present dozens of "buts." Hence an enormous amount of information about the war must be supplied and discussions of war philosophy stimulated, covering all angles of the various ideologies. In all citizens of the nation, regardless of their political and religious opinions, the belief must be created that there is no choice but to fight. . . . If this goal is attained, people will wish to enter into rather than escape from the warlike spirit. To produce the necessary conviction requires the teamwork of the best brains in the country, especially those best equipped in psychology, psychiatry, sociology, philosophy, ethics, law, and even politics.—Mira, Emilio: Psychiatry in War. New York: W. W. Norton Co., 1943.

Traumatic Vasospasm

MAJOR MICHAEL DEBAKEY
Medical Corps, Army of the United States

Traumatic vasospasm, sometimes referred to as "arterial concussion," "segmental vasospasm," and "stupeur d'artère," has long been recognized, but a satisfactory explanation of the pathological physiology has only recently been presented and is based on the studies of Leriche. Careful experimental and clinical investigations have shown that vasospasm is a natural response to those forms of trauma which directly or indirectly affect vascular structures. This vasospasm, depending on a number of factors, may occur in only a small part of the vessel, may spread to neighboring vessels of the entire extremity, or may be generalized to involve even larger areas of the body. While under certain conditions this vascular response to trauma may be a compensatory mechanism, if continued it produces undesirable and jeopardous effects on tissues. Indeed, a vicious circle may be established which becomes increasingly difficult to break. The practical significance of this type of vasospasm becomes more apparent in those cases in which the direct traumatism to the tissues has already seriously impaired their vitality. In such cases, vasospasm is frequently the deciding factor upon which the life of the limb depends. Moreover, in some cases the resultant ischemia may be a contributing factor in the development of gas bacillus infections.

Reflex vasospasm of this character commonly involves the main arteries of the extremities and may occur following direct or indirect injuries of these vessels. Obviously in some cases of direct injury to major vessels ligation will be necessary and should always be done by placing the ligatures well above and below the point of injury with excision of the intervening damaged segment. Other cases may be associated with thrombosis requiring excision of the thrombosed segment. These must be distinguished from localized segmental spasm of the artery. In cases manifesting this latter phenomenon the limb is cold, pale, and pulseless, but evidence of hemorrhage or hematoma indicat-

Prepared in the office of The Surgeon General.

ing that the vessel has been lacerated may not be present. Cases have been observed in which this type of reflex vasospasm was apparently initiated by trauma to tissues remote from the vessel. In one theater of operations there was reported a case in which a shell fragment produced a wound of entrance on the lateral aspect of the right calf at its mid-point and a wound of exit at the same level posteriorly. Although the wound track was at no point closer to the posterior tibial artery than 5 to 8 cm., at operation the artery was found in complete spasm for a distance of 10 to 15 cm. Other cases have been observed in which the wound was in proximity to the vessel but in which inspection revealed no grossly visible injury to the vessel wall, yet the artery was in complete spasm. Still other cases have been reported in which the spasm appeared following minimal manipulation of a simple fracture. The degree of vasospasm varies considerably from localized constriction with consequent minimal ischemia to a more extensive and generalized involvement, especially of the collateral circulation, with sufficient ischemia to produce actual gangrene. Moreover, the vasospasm may persist for varying periods and as long as, on even longer than, forty-eight to seventy-two hours.

Rational therapy in these cases is based on an attempt to counteract vasospasm and to produce maximum vasodilatation in the involved extremity. Since the disturbance is apparently due to the development of a vasomotor reflex initiated in the traumatized tissues and since vasoconstrictor impulses are transmitted by way of the sympathetic nerve fibers, interruption of these impulses in the circuit prevents vasospasm and permits vasodilatation. This may be done by débridement of surrounding tramatized tissue, periarterial sympathectomy, or novocain block of the regional sympathetic ganglia. The later procedure is probably the most effective method of producing maximum vasodilatation in these cases and should be employed in all types of peripheral vascular injuries accompanied by manifestation of vasospasm. It may be necessary to repeat the sympathetic block at least once or twice daily for several days.

The technique of novocain block of the sympathetic ganglia is extremely simple and may be performed as follows: For the lower extremities, lumbar sympathetic block is performed on the affected side, with the patient lying either in the lateral recumbent position or in the prone position with a pillow under the lower abdomen. The cutaneous sites of puncture are deter-

mined by taking a point about two and one-half to three fingerbreadths lateral to, and on a horizontal level with, the spinous processes of the first four lumbar vertebrae (figure 1). Each needle is inserted vertically until the transverse process of the vertebra is reached (figure 2). The direction of the needle is then changed slightly, passing either above or below the transverse process (figure 3), and the needle is inserted for an additional two and one-half to three fingerbreadths so that its point lies near the anterolateral surface of the body of the vertebra

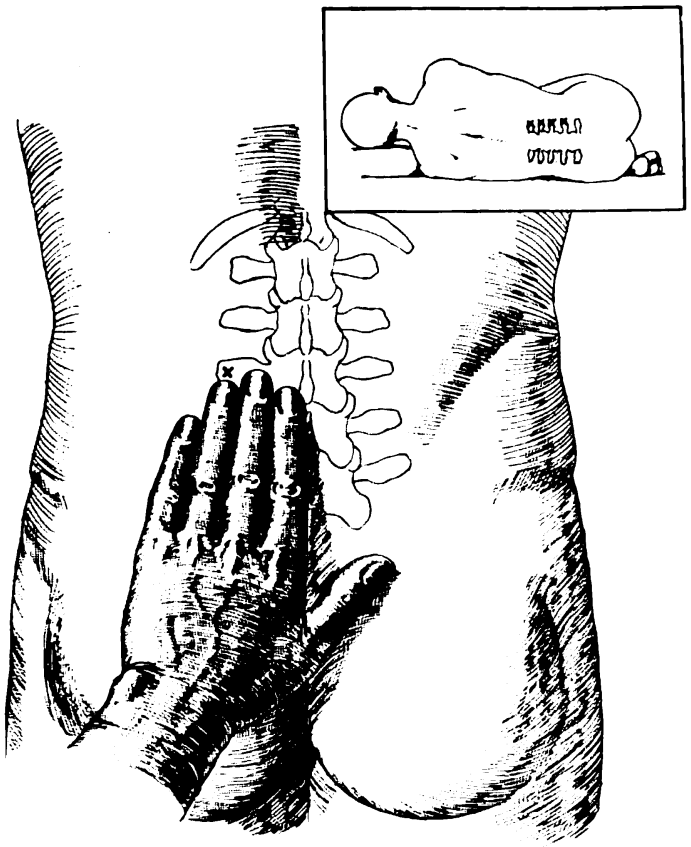
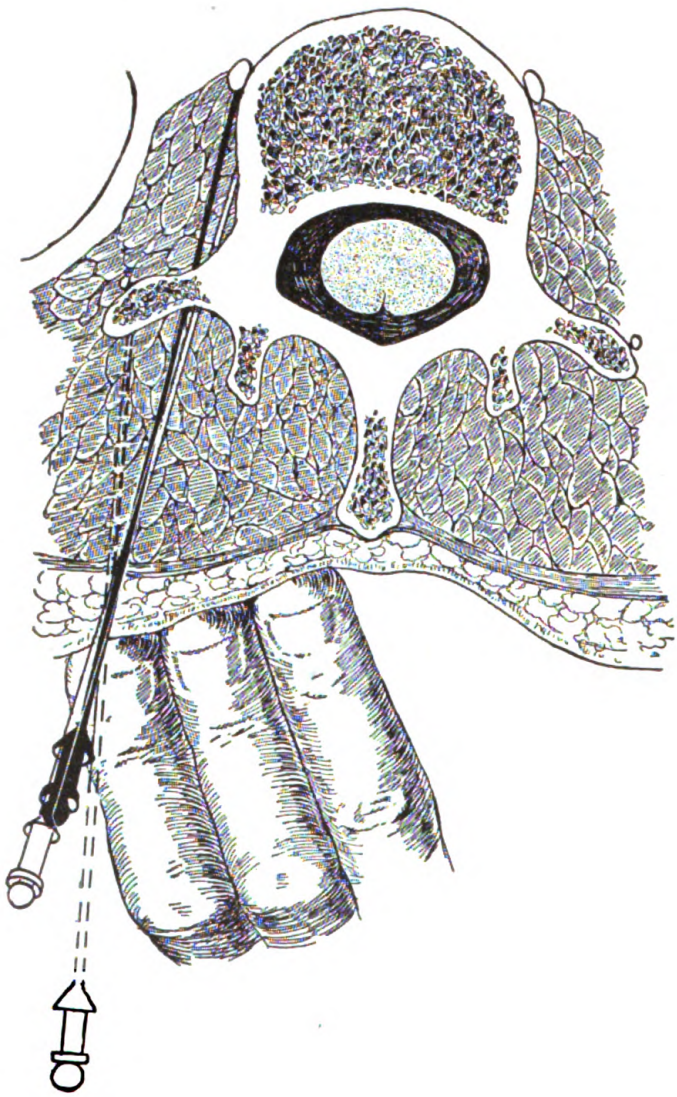


FIGURE 1. Technique of lumbar sympathetic block. Patient may be placed in supine position with a pillow under lower abdomen or in lateral recumbent position as shown in inset. The cutaneous sites of puncture lie on a horizontal level with and two and one-half to three fingerbreadths lateral to the upper part of the spinous processes of the first four lumbar vertebrae. This places the puncture sites in the skin directly over the transverse processes of the respective vertebrae.

in the retroperitoneal space where the sympathetic chain lies (figures 2 and 3). Five cubic centimeters of 1 percent procaine-hydrochloride solution are injected through each needle, care being taken to determine previously by aspiration that the needle is not in a vessel. A satisfactory injection is shown by the fact that within a few minutes after completion of the procedure the

FIGURE 2. Technique of lumbar sympathetic block. The needle is inserted vertically until the transverse process is reached (dotted needle). A point on the needle two and one-half to three fingerbreadths above the skin surface is taken and represents the distance the needle will be introduced further. The needle is then directed anteromedially and introduced above or below the transverse process so that its point impinges against the lateral surface of the body of the vertebra (white needle). The needle is then withdrawn slightly to slip away from the body of the vertebra and inserted until the point on the needle previously made has been reached.



Thus, the distance the needle is inserted beyond the transverse process is two and one-half to three fingerbreadths and represents the approximate distance between the transverse process and the site of the sympathetic chain. Because the sympathetic chain lies snugly against the anterolateral surface of the body of the vertebra it is desirable to keep the point of the needle during insertion close to the lateral aspect of the body of the vertebra until the needle has been introduced the required distance. The point of the needle will then lie near the sympathetic chain (black needle).

skin of the extremity on the affected side becomes warm and dry and the superficial veins appear more prominent. Duskiness or pallor of the skin is soon replaced by a more normal pinkish appearance and pulsations of the peripheral vessels (such as the dorsalis pedis and posterior tibial arteries), which on palpation were absent or feeble, return or become stronger. In cases

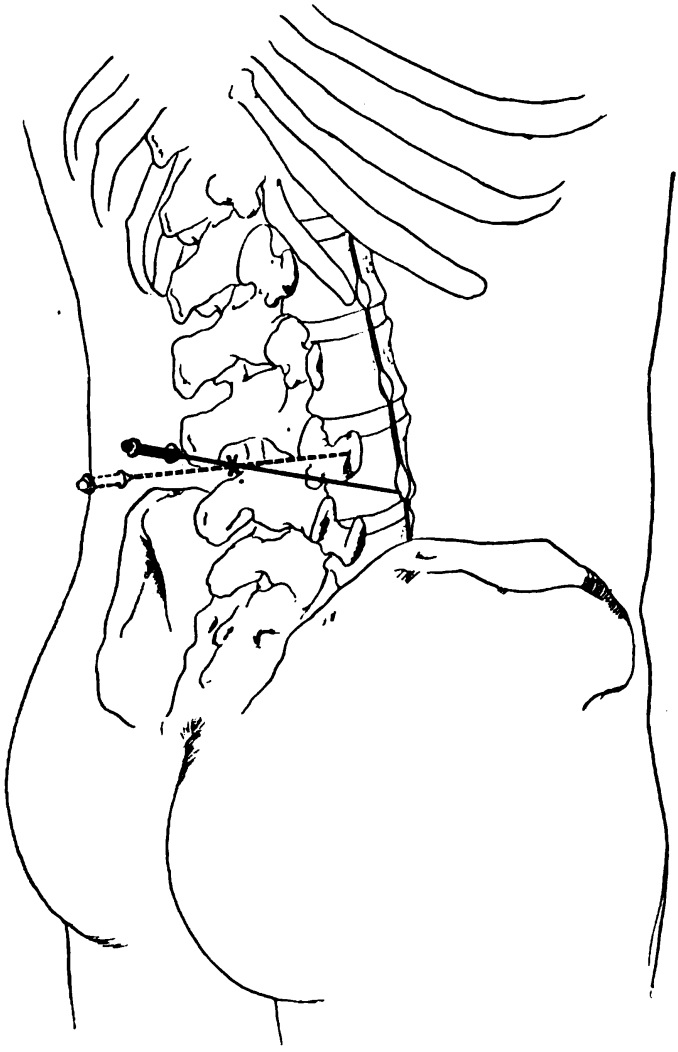


FIGURE 3. Technique of lumbar sympathetic block. Posterolateral view of lumbar vertebrae and sympathetic chain showing how needle is introduced either above or below transverse process toward sympathetic chain.

with involvement of the upper extremity, stellate ganglion block is performed with the patient in either the sitting-up or the supine position. A point 1 cm. medial to the mid-portion of the clavicle is chosen and an intracutaneous wheal of novocain is made in the skin immediately over the upper border of the clav-

icle. A fine lumbar puncture needle is introduced on a horizontal level with the clavicle and directed posteriorly and medially at a 45° angle with the midline. The point of the needle, after being introduced for a distance of from 6 to 7 cm., impinges against the anterolateral surface of the body of the seventh cervical vertebra or at the junction between the seventh cervical and first thoracic vertebrae, where the stellate ganglion lies. After ascertaining by aspiration that the needle is not in a vessel, 10 cubic centimeters of 1 percent novocain solution are introduced. A satisfactory injection is determined by the development of Horner's syndrome, anhidrosis, and an increase in warmth in the extremity on the injected side.

Japan and the Rice Famine in India.—One of the worst famines in India's recent history has been raging in the densely populated province of Bengal, which, with an area about that of the State of Idaho, supports more than 60,000,000 people, or nearly half as many as populate the entire United States. In the province of Bengal is Calcutta, second largest city in the British Empire, which normally receives most of India's rice imported from Burma and much of it imported from French Indo-China and Thailand. Japan now holds the three countries from which Bengal imported rice, and the necessity to maintain an army on the Burma frontiers reduces the quantity of rice which Bengal might obtain from Assam. The United States imports from Bengal burlap and jute, which are needed now for sandbags and camouflage cloth and for bags for grain and other foods. About 97 percent of the world's rice is grown in India, China, Japan, and neighboring countries of southeastern Asia, where millions of people eat little else.

According to Geographic School Bulletins of 15 November 1943, the United States raised 1 percent (66 million bushels) of the world's rice crop in 1942 and a still larger crop was harvested in 1943. Before this country was colonized by Europeans, rice grew wild in the United States and it still grows wild in some marshlands. White rice which was brought to North America and planted at Charleston, S. C., before 1700, at first was a more important southern crop than cotton. Our states have been led in rice production since 1889 by Louisiana, followed by Texas, Arkansas, and California. Rice-growing in the United States is done largely by machine methods without which we could not compete with oriental labor. For twenty-five years the United States has exported more than 20 percent of its rice. Our exports are four times the amount of rice imported. Cuba has been our best customer among more than fifty nations buying United States rice. About 25 percent of the rice harvest of 1942 was shipped to the Allied Nations.

The Drug Suppressive Treatment of Malaria

This is the third in a series of articles on malaria prepared in the Office of The Surgeon General. The first and second articles appeared in the November and December 1943 issues of the *Bulletin*.—Ed.

The use of drugs for the suppression of malaria, so-called prophylactic treatment, has been an established procedure for a long time. Quinine formerly was most widely used for this purpose, usually in daily doses of from 5 to 10 grains. Before the war, extensive trial had also been made of atabrine. The limitations of both drugs as a causal preventive of malaria have been well known; nevertheless, it should be stated here that neither drug will prevent mosquito-borne infection although either one, in proper dosage, usually will suppress the development of symptoms. Neither drug appears to be more efficacious than the other for this purpose.

With the extension of combat activities in highly malarious areas it has become necessary that large numbers of troops receive drug suppressive treatment. Because of the limitation of the quinine supply following the capture of the principal sources by Japan, atabrine has been almost exclusively the drug employed. The policies on the use of atabrine for suppressive treatment were stated in S.G.O. Circular Letter No. 153, of 19 August 43. The method recommended is to give 0.1 gram atabrine (1½ grains) once daily at the evening meal six days each week (total, 0.6 gram per week). An alternative method which has been satisfactory in some areas is to give 0.05 gram atabrine (¾ grain) once daily at the evening meal six days each week and a dose of 0.1 gram (1½ grains) at the evening meal on the seventh day (total, 0.4 gram per week).

It should be emphasized that drug suppressive treatment is an emergency procedure which should be employed only when troops must accomplish a mission in an area where there is substantial risk from malaria and where protection by mosquito control measures is not possible. When troops return to sanitated areas suppressive treatment should be discontinued as soon as feasible.

The question has been raised frequently about when to start suppressive treatment with atabrine. Experimental studies have shown recently that with the usual suppressive dosages the maximum plasma concentration of the drug is not attained until after three to six weeks. The institution of atabrine suppressive treatment several weeks in advance of exposure allows the achievement of a high plasma level of the drug by the time clinical symptoms might be expected to appear. There is considerable evidence, however, from experiments and practical experience that treatment in advance of exposure is not necessary for protection in the majority of instances. When treatment is started coincidentally with exposure, a protective level is apparently reached within the incubation period of the disease, at least when a dosage schedule of 0.6 gram per week is employed. Whether a higher plasma level at the time of infection would have additional advantage has not been determined.

TROOPS GOING INTO COMBAT

Other considerations are important in determining when to start suppressive treatment. If troops are to go into immediate combat on reaching a malarious area, there are substantial reasons for instituting treatment one or two weeks in advance. First, opportunity is afforded to discipline officers and men in the routine of taking atabrine. Second, such disagreeable reactions as may occasionally accompany the first few doses of the drug are experienced before the men are engaged in combat. Third, disturbed conditions during the first week of combat are likely to interfere with the establishment of a rigid routine of administering the drug. On the other hand, when men must travel to their destination by boat, seasickness may be a contraindication to the institution of atabrine suppressive treatment in the period preceding arrival in the malarious area.

The question about when to stop atabrine suppressive treatment is less controversial. In general, the drug should be discontinued as soon as feasible after return to a sanitated area, provided that it is no longer imperative that the men remain on active duty. When suppressive treatment is stopped most of the men who have been bitten by infected mosquitoes will develop clinical malaria. The majority will show symptoms within two or three weeks, although in some instances the period of latency may be extended for months. Suppressive treatment should not

be discontinued until men have reached a base where adequate medical care is available. When a large force returns from a hyperendemic area it is advisable to stagger the cessation of suppressive treatment in order that hospital facilities may not be overtaxed.

THE QUESTION OF TOXICITY

The question of possible toxicity from long continued use of atabrine for suppressive treatment must be considered. To date no ill effects whatever have been noted in large groups of men who have taken the drug continuously for periods longer than a year. There are reports in the literature of a small number of individuals who have taken atabrine suppressively for from five to seven years without discoverable toxic effects. Recently, experiments with animals have been done in various laboratories under the auspices of the National Research Council. No pathological changes have been found after 18 months in dogs fed atabrine in amounts comparable to the suppressive dose for man.

When suppressive treatment with atabrine is instituted it has frequently been observed that disagreeable reactions may accompany one of the first few doses. The extent to which reactions occur is variable. In some units no trouble has been experienced while in others a considerable proportion of those taking the drug have been affected. The untoward effects usually have consisted of nausea, abdominal cramps, or occasionally headache, vomiting, and diarrhea. These symptoms may be prevented in most cases by giving sodium bicarbonate or sweetened drinks with the atabrine. They are never serious and almost invariably soon disappear if the drug is continued. Intestinal disturbance often may be traced to failure to take the drug at mealtime as recommended.

Field reports and experimental tests suggest that psychological factors may be concerned in the gastro-intestinal symptoms sometimes associated with the institution of suppressive atabrine. The fact that such symptoms seldom occur following the larger dosages of the drug used in clinical treatment tends to corroborate this point of view. Reassurance before starting administration of the drug is important. It should be reiterated that such reactions as may be encountered are practically never an indication for stopping the drug. True intolerance for atabrine is rare.

At one time, rumors were circulated that atabrine had adverse effects on the physiological reactions of aviators. Extensive investigation, however, failed to show that atabrine in the usual doses has any effect whatever on flight capacities of flying personnel. Another rumor which gained credence was that atabrine of American manufacture was different from the German drug. Careful chemical studies have shown the two products to be identical.

Since atabrine is a dye, yellow discoloration of the skin occurs in a majority of the persons taking suppressive doses; occasionally the sclerae are also discolored. This pigmentation does not represent hepatic damage, is not dangerous, and is not an indication for discontinuing the drug. The discoloration disappears within a few weeks after atabrine is stopped.

In spite of the fact that publications from The Surgeon General's office have repeatedly stressed that no drug is known which will act as a causal prophylactic for malaria, and that suppressive treatment cannot be regarded as a true control measure, misunderstanding on this subject persists in many quarters. It is emphasized again, therefore, that suppressive atabrine merely prevents the occurrence of symptoms at an inconvenient time and if men have been extensively exposed to infected mosquitoes, noneffectiveness from malaria is only delayed.

The military importance of this fact has been demonstrated by the experience of our forces in tropical theaters. A unit which fought for five months in highly malarious territory had an average monthly malaria rate of about 1,000 per annum during this time. These cases occurred while suppressive atabrine was prescribed and represented so-called break-throughs. After the unit returned to a nonmalarious base and suppressive treatment was stopped, the malaria rate during the first month thereafter was 8,600 per annum, i.e., more than 70 percent of the men experienced a clinical attack. Four months later, relapse cases were occurring to such an extent that the malaria rate of the unit was still about 4,000 per annum, this in spite of the fact that no further exposure to the disease had occurred. This extreme example illustrates the true role of suppressive treatment in the conduct of military operations in malarious territory. *Suppressive treatment must be regarded only as a temporary*

expedient to keep men on their feet during a campaign. Ultimately, control of malaria must depend primarily on preventing men from being bitten by infected mosquitoes as far as this is possible. Full use should be made of individual measures of protection, such as repellents, mosquito nets, sprays, and protective clothing, especially when suppressive treatment is prescribed. If the risk of infection is sufficiently great to necessitate the use of suppressive drugs, it is all the more important to stress precautionary measures against mosquitoes under such circumstances.

ATABRINE AND CLINICAL ATTACKS

The effectiveness of atabrine in suppressing clinical attacks should be discussed. In the extreme example cited, a high malaria rate occurred in the unit in spite of the fact that suppressive atabrine was prescribed. This experience has been general among combat troops in highly malarious areas, although to a lesser degree. The extent to which failure to take atabrine regularly is a factor in allowing "break-throughs" is not definitely known. However, comparison of rates in units in which atabrine discipline is rigidly enforced with general field experience suggests that it is the principal reason for failure of suppressive treatment. Other reasons such as repeated infection, excessive fatigue, poor nutrition, and exposure to hardships probably play a part but there is no actual proof. In any event, for suppressive treatment to be effective it is essential that the drug be taken regularly. Experience has shown that a roster check with each dose is the only practical means of accomplishing this result. This is the responsibility of unit commanders. When men are on missions separated from their command it is important that they be given a supply of drug and explicit instructions for taking it.

The variability in the atabrine plasma level attained in a group of men given the same dosage of drug has been recently investigated in this country and overseas. In a certain percentage of individuals, the plasma level of drug remains significantly lower than the average for the group as a whole. Presumably these individuals are less well protected than the others and would be the ones in whom "break-throughs" might occur. Observations in the field have not been sufficient to establish definitely the plasma level of atabrine necessary to suppress symptoms. It is likley that this level is different in different individuals, depending on physiological and other factors.

The average atabrine plasma levels are higher in groups given 0.6 gram per week as compared with those taking 0.4 gram, and fewer individuals given the larger dosage fail to attain what is tentatively considered to be the suppressive plasma level. All other considerations being equal, it is logical to assume that fewer "break-throughs" will occur when the 0.6 gram per week dose is administered. Although comparisons are difficult unless conditions of exposure are carefully controlled, there is considerable evidence from field reports to support this point of view. Therefore, when suppressive treatment with atabrine is indicated, the dosage of 0.6 gram per week is recommended as affording protection to a greater percentage of individuals than is given by the dosage of 0.4 gram per week. No discoverable toxic effects have been reported following large scale administration of 0.6 gram per week.

Field reports from overseas and a few experimental trials suggest that the administration of atabrine in suppressive doses may be successful in curing a certain percentage of infections with *Plasmodium falciparum*. It is conceivable that suppressive doses could act as curative doses in those individuals who develop a plasma level higher than the average. Infections with *P. vivax* show a greater tendency to relapse and probably seldom, if ever, are cured by suppressive treatment.

The possibilities that continued administration of atabrine might lead to drug resistant strains of parasites and that suppressive treatment might be responsible for the large numbers of relapses observed in certain individuals have been suggested. There is no good evidence to support either of these hypotheses. Clinical attacks apparently respond well to therapeutic doses of atabrine irrespective of previous suppressive treatment.

The entire picture regarding the prevention of malaria would be changed by the discovery of a drug which would act as a true causal prophylactic. The search for such an agent has been intensively pursued ever since it became apparent that malaria would be a major medical problem for the armed forces. If this search is successful the prevention of malaria among troops in combat will be revolutionized and tremendous military advantage will ensue. In the meantime, the best use of agents now available can be made only after proper understanding of what they can and cannot accomplish.

The Hospital Ship Program

MAJOR HOWARD A. DONALD
Medical Corps, Army of the United States

Hospital boats were first used during the Civil War after the fall of Fort Donelson in February 1862. With few facilities available the Medical Department was then faced with the problem of caring for large numbers of wounded. The proposal to remove the sick and wounded by steamer to hospitals established along the Ohio River seemed to be the answer and the U. S. Sanitary Commission prevailed on the Medical Department to agree to try this mode of evacuation, which finally proved to be of inestimable value. The initial success of the Commission with this experiment stimulated many organizations and some state governments to provide similar means for use at such time as another emergency occurred close to waterways in the south and west, and the occasion was soon forthcoming in the Battle of Shiloh fought on the banks of the Tennessee River. The appearance of hospital steamers sponsored by state governments, however, created another problem which threatened the integrity of the Union Army. The vessels were sent to the battle area for the sole purpose of evacuating wounded soldiers who were natives of the state which had equipped the steamers, and a vessel equipped by one state would refuse to evacuate a wounded soldier from another state. Oftentimes state vessels would remove men who did not require evacuation, but were merely eager to return to their home state. This problem grew to such proportions that it was necessary for General Grant, during his expedition against Vicksburg, to prohibit transportation of sick and wounded men to any point north of Memphis. This situation embarrassed the Government, but furthered the efforts of the U. S. Sanitary Commission to gain the sanction in April 1862 of The Surgeon General to transport sick and wounded from battlefields by hospital steamers regardless of the state of origin of the men. As a result, the Secretary of War directed that a steamer be transferred to the Sanitary Commission and supplied

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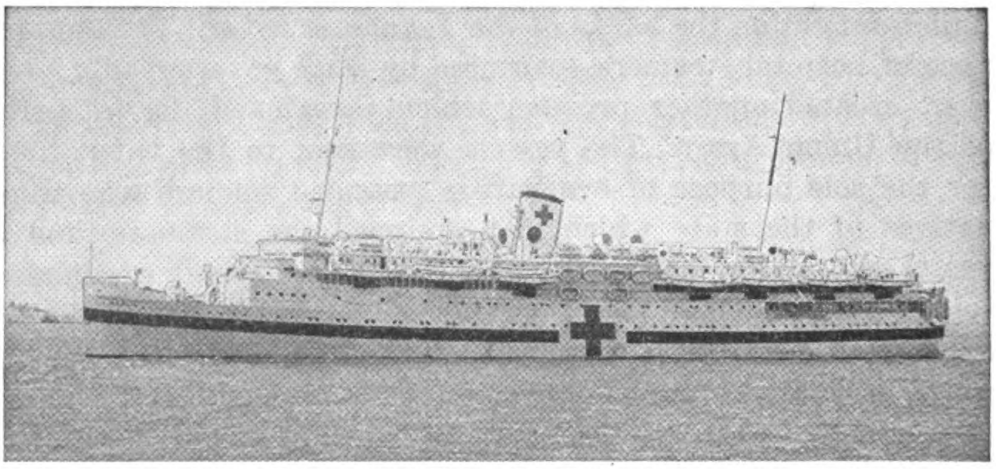
Prepared in the Office of The Surgeon General.

as a hospital steamer. The *Daniel Webster* was assigned for this purpose and was immediately dispatched to Yorktown, where in one day 250 men were comfortably transported to New York for further hospitalization. In the Peninsula Campaign more than 8,000 patients were evacuated in this manner.

During the Spanish-American War three vessels, the *Olivette,* the *Relief,* and the *Missouri,* were refitted for this purpose. During the World War, no hospital ships were authorized for the Medical Department of the Army, since the care of the sick and wounded who were returned from France was under the jurisdiction of the Bureau of Medicine and Surgery of the Navy.

MODERN HOSPITAL SHIPS

The need for hospital ships was not again realized until 1940, when a proposal fostered by the late Colonel Louis A. Milne, M.C., advocated the conversion of an Army transport for the purpose of returning patients from outlying bases to the



U. S. Army Hospital Ship *Acadia*

United States. The idea was temporarily dropped in the spring of 1941 on the grounds that one Convention-protected ship would be of little value and that such patients would be returned from overseas in the hospitals aboard regularly scheduled Army transports. Had this proposal been adopted at that time, the problem of evacuating patients during the North African campaign would have been simpler.

Photographs by U. S. Army Signal Corps.

This proposal, however, and the realization that the present war would take our forces to the corners of the earth, brought about the decision in 1942 to construct three new hospital ships to be operated by the Army. They were authorized in September and the keels laid on 1 December 1942. At that time the Navy took over supervision of construction of these vessels and agreed to operate them at the direction of the Army which would provide the medical staff. These vessels should be in service within the next few months.

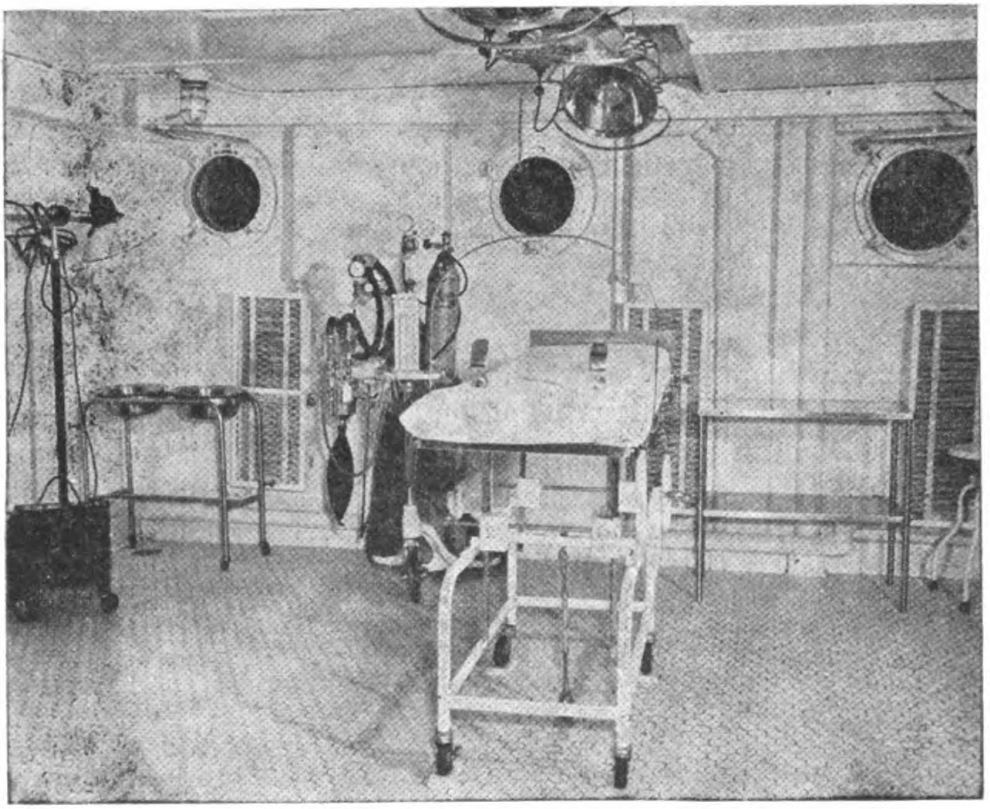
Overseas commanders in March 1943 requested the immediate services of two hospital ships. The U. S. Army transport *Acadia,* which had been put into service as a designated ambulance ship but which transported troops and was not registered under the terms of the Geneva Convention, was selected for immediate conversion into a Convention-protected hospital ship. The *Acadia* was placed in service as a hospital ship in May and the *S. S. Seminole* in July 1943. Obviously a larger number of hospital ships would be necessary and it was decided to formulate a construction program for a fleet of twenty-three hospital ships. This program is now being accomplished.

In making plans for Army hospital ships, the actual transportation of sick and wounded to zone of interior hospitals was stressed rather than floating hospitals with elaborate facilities for treatment. Facilities for as many patients as possible without causing them discomfort in any way and for only absolutely necessary emergency treatment on board ship have been provided, including operating, x-ray, dressing room, and dental facilities. The largest components of the hospital have been dedicated to wards in contrast to the facilities on hospital ships operated by the U. S. Navy which have an ear, nose, and throat section, genito-urinary section, hydrotherapy, physiotherapy, electrotherapy, and endoscopic rooms. Since Navy hospital ships are frequently used in protracted fleet maneuvers, such facilities are necessary.

The vessels being converted into Army hospital ships range from six thousand to nine thousand tons and are fitted for from 300 to 800 patients. They must be painted white and marked with red crosses and green stripe called for by the Geneva and Hague Conventions; must travel fully lighted between sundown and sunup with the red crosses illuminated by flood lights; must transport convention-protected personnel and equipment only; and abide by all the terms and provisions of these treaties. The

interior has been standardized as much as possible. Medical officers and nurses are quartered on the deck below the bridge deck, the nurses aft, the officers forward. If additional space is available forward of the officers' quarters, it is used for a ward. The commanding officer has a single room with an office adjacent. The chiefs of the medical and surgical services also have single rooms; all other medical officers live two in a room. The chief nurse has a single room with an office adjacent and other nurses are quartered in rooms of two, three, or four capacity. All rooms on this deck have toilet facilities.

The next deck below, the main hospital deck, is fitted with wards and the surgical suite, the latter being slightly aft of the center of the vessel and composed of two large operating rooms



Operating room of Army Hospital Ship *Shamrock*.

separated by a sterilizing and workroom. In this area are the surgeon's office, the x-ray and darkroom, the dental surgeon's office and treatment room, a nonsterile and a sterile supply and issue room. The operating rooms have all equipment necessary

for any emergency operation. The sterilizing and workroom has two dressing sterilizers, water sterilizers, and instrument and utensil sterilizers. The x-ray room and dark room have standard field x-ray equipment for fluoroscopy, roentgenography, and superficial roentgenotherapy. The dental surgeon is provided with equipment similar to that in an Army land hospital of similar size. Nearby is a patients' elevator to facilitate the portage of patients to this area and the wards and clinics on lower decks.

WARD DECKS

The wards on this deck vary from 6 to 100 patient capacity. Several small wards are equipped for officers, nurses, or critically ill patients. Large wards have an office, utility room, cleaning gear locker, linen locker, and diet kitchen; similar facilities are provided for each group of small wards. Wards for litter patients are on decks above the waterline.

The next deck below is composed entirely of wards. In the aft section, which is the isolation area, the wards are restricted to a capacity of from 2 to 8 patients. This area is completely isolated from the remainder of the vessel.

The forward and part of the midship area of the deck above the waterline of the ship are allocated for the crew. The area aft of the forward crew section is the clinical and administrative section of the hospital and ship. Here are the main dressing station, pharmacy, laboratory, prophylactic station, Red Cross office, medical records office, dietitian's office, chaplain's office, transportation agent's office, and post exchange, all in the vicinity of the forward gangway or side port entrance. On this deck also are the galley, pantries, mess rooms, and quarters for Medical Department enlisted men, separated mostly into two or three components, each containing three-high berths and, where possible, grouped about a central recreation room. On this deck aft and completely isolated from the remainder of the vessel is the mental area, although ambulatory neuropsychiatric patients are quartered on the deck below. At designated hours such patients as are considered in proper condition are permitted the facilities of the recreation room under guard.

The waterline deck is for ambulatory patients and storage facilities; the two forward holds are for medical stores, morgue, and autopsy room; hold No. 3 is used either for steward's stores

Laundry of the Hospital Ship *Acadia*. This laundry is typical of those in other Army hospital ships. In addition to the equipment shown here, a disinfector is available on board for the sterilization of mattresses and clothing. The equipment is sufficient to launder all hospital linens in addition to the laundry work of the personnel on board; it is comparable to the equipment found in many land installations of similar and somewhat larger size. The ship's laundry is operated by twelve men from the Medical Detachment. Without such laundries, hospital ships necessarily would be required to carry larger supplies of linen and to remain in port longer or until the ship's laundry work was finished.

or it may be fitted with two-high berths for ambulatory patients, ward office, utility room, and linen locker. The aft-midship section is for refrigerated cargo. The area directly below the mental area on the deck above has several large wards for mild, neuropsychiatric patients. This area connects directly with the area above where these patients use the mess room and the mental patients' recreation room. The aft end of the deck immediately below the neuropsychiatric area is for the ship's laundry, linen storage space, and a disinfecting apparatus for mattresses and clothing.

The personnel aboard these vessels comprise the civilian merchant marine crew responsible for the operation and maintenance of the vessel and the medical complement responsible for the care of patients and operation of the hospital. The number of medical officers assigned will vary between five and thirteen, including a surgeon, internist, and, on the average-size ship, an x-ray specialist, laboratory man, psychiatrist, and sometimes an EENT specialist. The remaining officers include from one to three dental officers, one to three chaplains, two to five Medical Administrative Corps men, one Sanitary Corps officer, and one warrant officer. Other personnel include from twenty-three to fifty-two nurses, one dietitian, and two Red Cross workers who obtain financial aid for patients without funds and assist in writing letters and in contacting relatives. The enlisted men aboard will vary between eighty-two and two hundred and eighteen.

An Army hospital ship already in service transported ten thousand patients in a period of six months, a figure which, however, does not indicate the actual number of patients returned from theaters of operations, as many of them were transported within the theaters more than once. It is improbable that this movement could have been done by Army transports alone without upsetting the troop movement schedule. Furthermore, the removal of these patients in comparative comfort to fixed hospitals, a long distance from the front, no doubt improved their chances for complete recovery.

Colostomy

The Director of Medical Services of the Middle East Forces, on 31 May 1943, issued memorandum notes on the surgery of the colon and rectum. Colostomies may be difficult to close for the following reasons:

1. A short, taut loop of colon being brought out of the abdomen.

2. Infection in the abdominal wall, especially when a large incision has been used.

3. Wide separation of the loops with interposition of mesentery or abdominal contents.

4. Midline colostomy. In this region the abdominal wall is comparatively thin. Mobilization and extraperitoneal closure are difficult. Furthermore, application of an enterotome may endanger large blood vessels.

The following points in technique at the primary operation are put forward to make the subsequent closure of a temporary colostomy safer and easier. It may be impossible to carry out all these suggestions owing to the urgency of the situation, but forward surgeons should remember that closure of the colostomy will be less of a risk if they are adopted.

1. Apart from the tranverse colon, colonic loops lie more snugly in the lateral areas of the anterior abdominal wall. It is therefore recommended that after dealing with the intra-abdominal wounds through a centrally placed exploratory incision, the damaged colonic loop should be extraperitonealized through a small lateral incision in the hypochondriac regions or iliac fossae. This small incision is placed so that the colonic loop is in it slackest position when drawn through it. The abdominal wall is thicker and it layers are placed obliquely to one another in these lateral regions. This makes sound closure of the parietes more certain. The colon should be pulled through the lateral incision by means of a small loop of rubber tubing passed through its mesentery at the border of the gut. The exploratory wound may then be closed quickly with less risk of sepsis.

2. The longer the loop, the easier is final closure. The colon should therefore be mobilized as far as possible and the apex of a loop used when performing a temporary colostomy.

When the splenic angle is damaged, mobilization through a separate oblique subcostal incision may eventually save time.

3. The loop having been pulled through the small lateral incision, approximation of its two limbs by suture adds little to the operation time. The sutured limbs of the colon are returned to the abdomen and should lie loosely and parallel in a lateral quadrant.

4. The colon should be allowed to act as a colostomy as soon as the abdominal incisions are closed. The wound of the colon need not be sutured once it is extraperitonealized. A hole or holes may be temporarily controlled by the use of tissue forceps introduced through the lateral incision before being applied and used to ease the gut through it.

5. The colon may be fixed to the parietes by means of a loop of rubber, an unbroken tube of catgut, or the incorporation of an appendix epiploica. A forceps holding the gut and then strapped to the skin for twenty-four hours will also suffice.

In all cases of wounds of the colon, accurate notes concerning the site of the damage and method and difficulty of operation should be recorded on the Field Medical Card for the guidance of the surgeon who has to close the artificial anus.

THE CLOSURE OF COLOSTOMIES

When the loops of the colon have been sutured together at the first operation, an enterotome should be used. The enterotome may be applied even though there is infection in the wound. The final operation for closure should not be performed, however, until the parietal wound has healed.

In many instances it will be safe to use an enterotome, even though the limbs have not been sutured, if it appears likely that the colostomy has been made in a fairly mobile loop of colon. The proximity of the two loops, the presence of intervening structures, and the relation to other intra-abdominal contents can be assessed by palpation with an index finger in each loop. When the fingers cannot touch easily throughout the length of the loops, it is unwise to apply an enterotome. Furthermore, colostomies near the middle line with unsutured loops should not be closed by crushing the spur.

Application of the Enterotome

The blades are introduced into the loops, guided by the finger. The instrument is allowed to lie comfortably in the lumen of the gut. It is then slowly tightened and when lightly

gripping the walls of the bowel, its intra-abdominal portion must be quite free.

As the limbs of the clamp are approximated, the patient may complain of discomfort in the region of the umbilicus. Severe abdominal pain, vomiting, or persistent nausea usually means that a portion of mesentery has been caught up, or that owing to the obliquity of the limbs the mesentery is being dragged upon as they are approximated. Obstruction of the blood supply of the stomata may also be seen. Under these circumstances or if the patient complains of pain in the back or a desire to pass urine, the instrument must be removed and the attempt abandoned.

The engaged enterotome projects well above the level of the abdominal wall. In order to protect it from pressure and alteration in position, a wall of cotton wool is made around it and then a small inverted enamel bowl placed over it, the whole being bandaged onto the abdomen. The instrument is tightened daily and will cut through in six to eight days.

The smaller the spur the easier the closure. If after the first crushing the spur appears to be near the surface, reapplication of the enterotome may be possible. A projecting spur can often be flattened by introducing a thick piece of rubber tubing into the stoma.

Following adequate crushing of a spur, the colostomy becomes a faecal fistula and faeces will pass into the lower loop. Small enemata or glycerine suppositories are used to stimulate the distal gut.

Closure of the faecal fistula should be carried out about seven to ten days later.

Preoperative Treatment

The distal loop is washed out with normal saline every day for four days before the operation.

The proximal loop is washed out a few hours before operation.

The stomata are lightly plugged with gauze soaked in Bonney's blue or triple dye.

Technique

Extraperitoneal closure should be performed if possible.

1. When isolating the gut from the parietes, a narrow margin of skin should be left attached to the mucosa of the stoma.

2. The loops should be dissected completely free of all the layers of the abdominal wall without opening the peritoneum. If the cavity is opened slightly, it should be closed at once.

3. Complete mobilization of the loops is essential. The gut is not free until it can be placed easily under the layers of the abdominal wall. During the final stages of dissection, a finger introduced into the lumen of the gut and gentle outward traction on the loops will facilitate mobilization.

4. The mobilized gut is now wrapped in a swab and the layers of the abdominal wall defined.

5. Gauze swabs wrung out with spirit are used to protect the dissected abdominal wall whilst suture of the gut is performed.

6. The skin fringe is next removed from the stoma without sacrifice of mucous membrane. This maneuver will allow the oedematous everted mucosa to invert. Further, there is now a little more bowel wall available for suture.

7. The stoma is closed. Connell's stitch (loop on mucosa) is essential for inversion of the oedematous mucosal edge. At least two layers of sutures are used. Finally a few interrupted sutures incorporating odd areas of the peritoneum-covered fat are put in to reinforce the suture lines.

8. The sutured gut should lie snugly under the parietes which is then carefully sutured in layers; sulphanilamide powder is sprinkled liberally in each layer.

9. Drainage is important. The site of the suture line and the subcutaneous tissues should be drained. The drains are brought out through opposite ends of the skin incision and lie as obliquely as possible.

Closure Without the Use of an Enterotome

Closure is more difficult and opening of the peritoneum is usually necessary. However, if the loop is fairly mobile, it may be possible to perform an extraperitoneal operation.

To prevent narrowing at the level of the suture line, it is advisable to enlarge the stoma longitudinally and then to sew it up transversely. If possible the omentum is used to isolate the sutured area, and sulphanilamide powder placed in the wound. Two drains are inserted, one down to the sutured gut and the other into the subcutaneous tissues.

POSTOPERATIVE TREATMENT

Only sips of fluid are allowed by mouth. All fluids are given intravenously.

Oral fluids are started when intestinal sounds can be heard.

A small enema, 5 to 10 oz., should be given daily after the fifth day.

Aperients should not be given for eight to ten days, and liquid paraffin should not be administered.

The subcutaneous drain is removed after twenty-four hours, but the deep drain should be shortened daily after forty-eight hours and not removed until the fourth or fifth day.

Advances in Military Medicine in 1943

MAJOR JOHNSON F. HAMMOND
Medical Corps, United States Army

A period of warfare has the effect of stimulating medical progress. More intense efforts are applied to medical problems and a greater multitude of highly skilled workers cooperate in providing the best possible preventive and therapeutic measures for the military forces. More than ever during 1943, this nationwide medical movement sprang not from military agencies alone, but from the universities, colleges, research institutions, laboratories, and allied civilian organizations. Numerous military medical advances were realized in this comparatively brief period while others were conceived and are now in the developmental stage. Only a few of them are mentioned here.

TYPHUS

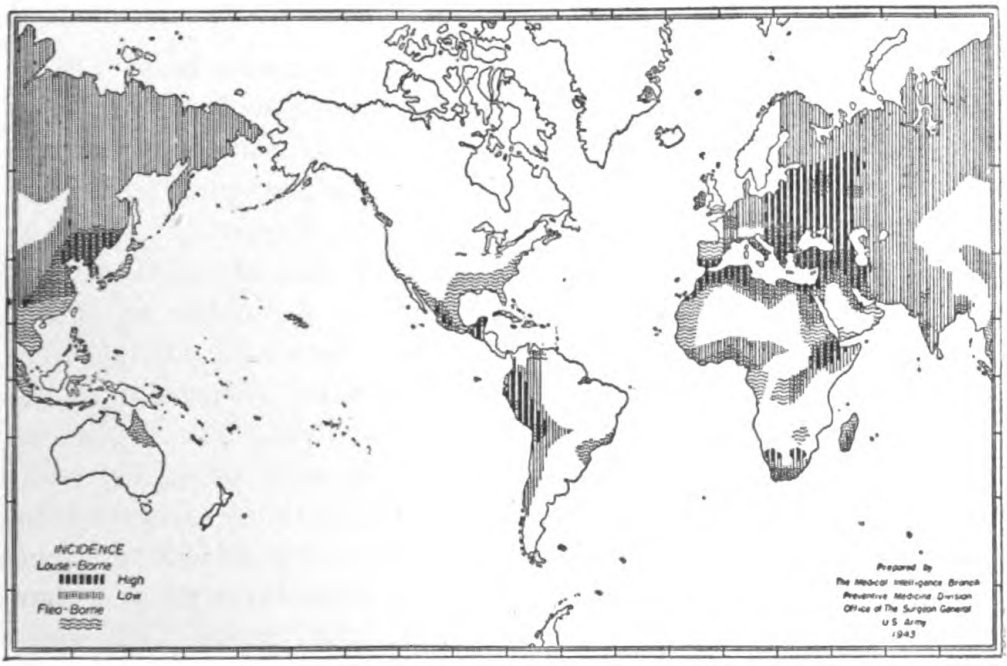
Typhus fever, which has wrought havoc in armies and civilian populations in the past, was prevalent in Russia and Central Europe during the last great war, but no proved cases appeared in the American Expeditionary Forces. Many of our troops during 1943 served in typhus-infected areas, and louse-borne typhus steadily increased[1] among the native populations of North Africa and the Near and Middle East since hostilities

1. Simmons, James S.: The Present State of the Army's Health, J. A. M. A., 31 July 1943, p. 911.

began. The Surgeon General's Office foresaw the possibility of outbreaks of typhus and took precautionary measures. The typhus situation was constantly watched long before American troops invaded Africa, and, as that event approached, the need for definite typhus control measures became clear. By Executive Order, on 24 December 1942, the President established the United States of America Typhus Commission,[2] which in turn established its forward echelon in Cairo. The Typhus Commission collected many strains of typhus virus.

Our troops serving in or preparing to go into typhus-infected areas were vaccinated against typhus. There was developed at the Army Medical School[3] a means by which the types of typhus prevalent in a country can be determined. By this means, the complement fixation test, epidemic typhus

GEOGRAPHICAL DISTRIBUTION OF TYPHUS FEVER



was discovered in a South American country and similar surveys are being made in other countries. Previously it had not been possible to differentiate by this method between epidemic and endemic typhus antisera. Serologic evidence was obtained to substantiate a theory advanced by Zinsser that Brill's disease represents a recrudescence of an old attack of typhus. The implications from that discovery are that mild cases of epi-

2. Bayne-Jones, Stanhope: United States of America Typhus Commission. Army M. Bull. No. 68, July 1943, p. 4.
3. Plotz, Harry: Complement Fixation in Rickettsial Diseases, Science, 1 Jan. 1943, Vol. 97, pp. 20-21.

demic typhus actually exist in the United States, and that one attack of typhus does not confer lifelong immunity, as was generally believed. Recent observations on Brill's disease strongly suggest[3] that man serves as the reservoir for epidemic typhus between outbreaks, as the rat does in endemic typhus.

An agent was developed by The Surgeon General's Office which will completely delouse clothes in thirty minutes using very simple equipment in comparison to the cumbersome and expensive method used in the last war; in addition, a powder was developed which when sprinkled once in the seams of clothing will keep insects away for at least two weeks. The typhus prevention program, therefore, was far advanced during 1943. While final conclusions may not yet be warranted, the fact is that American troops in Africa have been practically free from typhus fever.

PENICILLIN

Penicillin, an extract of cultures of a common mold (*Penicillium notatum*), is a new therapeutic agent with potent bactericidal properties. Amazing results in the treatment of certain infections with penicillin were obtained. Further purification of the extract together with additional clinical studies offers great promise as we enter the new year. During 1943, clinical studies of penicillin therapy[4] in surgical infections in a number of Army hospitals were sponsored by The Surgeon General's Office with the cooperation of the Committee of Medical Research of the Office of Scientific Research and Development. The report of the treatment of septic gunshot fractures with penicillin indicates that dramatically successful results may be achieved by the meticulous surgeon who combines penicillin, effective blood transfusions, and conservative surgical procedures into a program of thoughtful management of individual cases. This well-planned clinical and laboratory investigation revealed that a major deficiency of red blood cells and hemoglobin occurs in such cases. Since the regeneration of red cells and hemoglobin depends on control of the infection, penicillin was found to be "dramatically" effective in rapidly establishing this phase of convalescence. Penicillin permits a direct surgical approach to the management of septic gunshot fractures. Its role in this regard is said to be analagous to the use of vitamin K in patients

4. Lyons, Champ: Penicillin Therapy of Surgical Infections, J. A. M. A., 18 December 1943.

with obstructive jaundice. That concept, the report states, emphasizes the limitations of penicillin therapy and designates the supplemental position of penicillin in the over-all surgical program.

BURNS

The National Research Council during 1943 sponsored studies in various clinics on the treatment of burns. Progress on this important subject is expected to develop. It is agreed at present that the prevention and treatment of shock in every severe burn is the first indication and should precede any definitive treatment.[5] The most important early general complication in burns is loss of plasma volume due to leakage of plasma into interstitial spaces. This, it was found, can be largely prevented by firm pressure bandaging and can be controlled by plasma transfusion. About eighty methods of burn therapy have been

Officers and enlisted men in Australia carrying portable hospital litter poles with canvas slung over them.

published. While there is some disagreement regarding the best therapy, the pressure bandage method is rapidly gaining popularity. The studies now under way by the several Burn Projects and the National Research Council, when assembled and analyzed, will give valuable therapeutic, pathologic, and bacteriologic data on this subject.

5. Whipple, Alan O.: Basic Principles in Treatment of Thermal Burns, Ann. Surg., August 1943, p. 187.

Photographs by U. S. Army Signal Corps

PORTABLE HOSPITAL

A very important advance in military medicine was the creation and use of the small portable hospital[6] which is carried forward near the battle front, by hand, if necessary, in order to provide emergency surgical aid soon after soldiers are wounded. This and similar installations which bring medical aid nearer the front were factors in a pronounced reduction in mortality rates among our fighting men in contrast to those of World War I.

Natives carry a wounded American soldier from the battle to a portable hospital in New Guinea.

SURGERY OF COLON

An important advance in surgical technique in the treatment of wounds of the colon,[7] apart from the transverse colon, was the exteriorization at the time of the primary operation of the damaged loop of colon through a small lateral incision in the iliac fossa or the hypochondriac regions after which the exploratory central incision was closed quickly. The colonic loop having been pulled out through the lateral incision was not

6. Marks, George A.: Portable Surgical Hospital at Buna, Bulletin of the U. S. Medical Department, No. 71, December 1943, pp. 43-55.
7. Colostomy, The Bulletin of the U. S. Army Medical Department, this issue, p. 42.

then subjected to further surgery but allowed to serve as a colostomy. This made safer and simpler the primary operation on wounds of the large bowel and reduced the danger of sepsis.

PLASMA AND AIR EVACUATION

A medical achievement more extensively used near the front, sometimes even in foxholes, last year, was the administration of blood plasma to soldiers in shock and to the severely wounded. The blood which our people at home generously donated through the facilities of the American Red Cross thus became a means of saving many fighting men who, if similarly wounded in the last great war, would have died. The development of evacuation by airplane of severely wounded patients from the front to base hospitals in the zone of communications and to the homeland was very extensive and much more successfuly used in various theaters of operations.

SULFONAMIDES

Wounded and sick soldiers were greatly benefited by the more extensive use of the sulfa drugs which were taken with them to the battle fronts. The sulfonamides prevented many serious systemic infections and were very important in reducing the mortality rate in meningitis from 39 percent in World War I to a present rate of about 4 percent, and the pneumonia mortality rate from 25 percent to 4 percent. The management of gonorrhea in the Army was radically improved and the complications of streptococcal infections, scarlet fever, and measles were greatly reduced by means of the sulfonamides.

RESEARCH

The Surgeon General's Office was and still is much interested in research. The Virus Laboratory at Walter Reed General Hospital was rapidly expanded. Research on the medical aspects of tank warfare was accomplished at the Armored Forces Medical Laboratory at Ft. Knox, and on equipment in the laboratory at the Medical Field Service School at Carlisle Barracks. The Army Industrial Hygiene Laboratory at Johns Hopkins University investigated, among other things, equipment and materials used by the Army with reference to toxicologic considerations, and offered its services to all Army installations for the chemical analysis of materials with reference to the presence of toxic substances.

HOSPITAL TRAIN

Among the many improvements in medical equipment accomplished, was the first overseas type of hospital train specially designed for use in combat areas built in the United States. This train was exhibited to the public in various cities—Boston, Jersey City, Philadelphia, Washington, D. C., Cincinnati, St. Louis, Denver, Salt Lake City, and San Bernardino, Calif.—where 65,000 persons came aboard. Trains of this type are for the removal of sick and wounded from the evacuation hospitals which are usually within 25-50 miles of the front lines to the larger general hospitals perhaps hundreds of miles to the rear.

OUTLOOK FOR 1944

During 1943 United States soldiers served their country practically all over the world. They faced not only the enemies' armed forces but also many new health hazards.[8] The Medical Department forces went with and served our fighting men so effectively as to constitute a definite military medical achievement which has been widely recognized.[9] The outlook for the future has been expressed by The Surgeon General: "Our fighting men can be assured," General Kirk said, "that in battles still to come they will continue to receive the best treatment that medical science can offer and the best care that the skilled and loyal men and women of the Medical Department can bestow."

8. Simmons, James S.: The Preventive Medicine Program of the United States Army. Am. J. Pub. Health, Vol. 33, August 1943, p. 932.
9. The Bulletin of the U. S. Army Medical Department, No. 71, December 1943, pp. 14-15.

How P. falciparum Kills.—The answer to this question is not far to seek, though the actual mechanism is not known. Falciparum parasites cause the red cells to stick to each other and to the walls of the capillaries, so that the normally smooth flow of the blood is interrupted. Not only are the parasitized corpuscles sticky, but also the uninfected red cells, the leukocytes, and the endothelial lining. Consequently, the capillaries of vital organs become choked with thrombi thus formed, vessels rupture, infarcts occur, and irreversible damage results when such tissues as the brain are involved. Falciparum therefore kills not because of some powerful toxin or metabolic disorganization, but by causing agglutination of the red cells. It is mechanical obstruction and apoplexy of some vital blood vessel which causes death in malignant malaria.—Hudson, Ellis Herndon, Lt. Comm. M. C., U.S.N.R.: The Malaria Problem, M. Clin. No. Am., 77:1421, September 1943.

Original Articles

The Principles of Treatment in Peripheral Nerve Injuries

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Bullet and shrapnel wounds of peripheral nerves are common injuries among war casualties. Many different types of repair of peripheral nerve injuries were carried out in the last war, but no standard test of recovery of function was applied and few cases were followed long enough to justify conclusions. At least three to five years should elapse after repair of an injured nerve, with a careful analysis of the electrical activity and muscle group function on a standard basis, in order that results can be compared. Possibly when this war is over, our organization will have been so planned that such a study can be completed. That kind of program has just been put into effect.

PATHOLOGY

Nerve injuries in war differ from those in civil life in that immediate suture of a divided nerve is almost never possible largely because of infection. Bad results following nerve suture in septic wounds are due to intense formation of connective tissue within and without the nerve. Thus a barrier to the regenerating nerve fibers develops. It is well established histologically, that following complete severance of a nerve, the proximal segment degenerates for a distance of 1 to 2 cm. back to a node of Ranvier, and then attempts at regeneration occur with the frequent formation of a stump "neuroma." The distal segment of the nerve degenerates in its entirety, and the process is complete in about three to four weeks. Naffziger and Aird[1] point out that all parts of the neuromuscular apparatus—the nerve peripheral to the injury, the motor end plates, and the innervated muscle fibers—degenerate. Experimental studies tend to show that the loss

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1. Naffziger, H. C., and Aird, R. B.: The Regenerative Capacities of Nerve and Muscle. An Experimental Study of the Factors Causing Faulty Recovery of the Neuro-muscular Mechanism, Journal of Mt. Sinai Hospital, New York, Sachs Anniversary Volume, 9:679, Nov.-Dec. 1942.

of contractile muscle units and the progressive fibrosis within the paralyzed muscle, play a major role in the failure of muscular recovery following delayed nerve repair. Immediate suture of the nerve, therefore, is always desirable when possible, to enhance regeneration before too much scar tissue has formed. It is reasonable to assume that nerve fibers will grow into a peripheral stump better from parallel columns placed end-to-end than from an end-bulb in which bundles of nerve fibers run in all directions.

Huber,[2] Head,[3] and others concluded that the average rate of regeneration in a divided peripheral nerve was about 1 mm. per day after the axon tips crossed the line of anastomosis. Trotter and Davies[4] showed clearly that the regular advance in recovery was essentially equal for all modalities of sensation. Gutmann et al.,[5] who have re-investigated the problem, observed in rabbits the reflex responses in the exposed nerve distal to the point of suture. They point out that "before recovery takes place after suture of the cut ends of a divided nerve, the regenerating fibers must pass through three phases: (1) They undergo retrograde degeneration, branching, and the relatively slow process of outgrowth across the suture scar. (2) The tips of the axons advance down the peripheral stump and make connection with the end-organ. (3) The newly formed fibers increase from their first tiny diameter and acquire myelin sheaths (maturation). It is only after the processes under the third heading have reached a certain stage that function returns." They conclude that the "scar delay" from the proximal stump across the suture line to the peripheral stump is about seven to ten days, but that there is a further delay due to maturation of the nerve, giving a total latent period before advance of recovery of about thirty-six days after suture and about twenty days after crushing of a nerve. In the downgrowth of the nerve in the peripheral stump, the rate of functional regeneration is about 2 mm. a day after suture and 3 mm. a day after crushing. They believe the rate is similar in man. The latent period in a secondary delayed suture following an infected war wound or neuroma

2. Huber, G. C.: Observation on the Degeneration and Regeneration of Motor and Sensory Nerve Endings in Voluntary Muscles, Am. J. Physiol., 3:339, 1900.
3. Head, H., and Sherren, J.: The Consequences of Injury to the Peripheral Nerves in Man, Brain, Lond., 28:116, 1905.
4. Trotter, W., and Davies, H. M.: Experimental Studies in the Innervation of the Skin, J. Physiol., Lond., 38:134, 1909.
5. Gutmann, E., Guttmann, L., Medawar, P. B., and Young, J. Z.: The Rate of Regeneration of Nerve, J. Exp. Biol., Lond., 19:14, May 1942.

excision is not known definitely. However, an approximate timetable for expected evidence of regeneration in man has been set up by the National Research Council and published in volume VI of the Military Surgical Manual (Neurosurgery and Thoracic Surgery).[6] The figures suggest that under poor conditions the main nerves in the extremities require eight to twenty-two months for the return of function, depending on the level of the injury and the condition of the site of injury; under good conditions, with little delay and good mechanics of suture, the time varies from five to sixteen months.

DIAGNOSIS

When a diagnosis of a nerve injury has been made, it becomes necessary to determine two facts: (1) which nerve or group of nerves has been injured, and (2) is the injury one of anatomical destruction or is it only physiologic, as by compression, with the nerve contour still intact. In closed fractures, for example, division of a nerve occurs infrequently and nerve suture is rarely indicated. In open penetrating wounds either condition may obtain, and therefore careful inspection of the wound must be made to determine treatment. The fact that a bullet or shrapnel penetrated a nerve by no means indicates that the anatomical continuity of the nerve has been markedly disturbed. We have carried out definitive treatment on many such cases. We had felt certain that the nerve had been completely divided but at operation were surprised to find it was intact, or nearly so, with its physiology disturbed by scar tissue or that the nerve had just been "nicked" by the fragment. There is apparently sufficient mobility of the nerve in its bed frequently to allow the missile to push it aside. The infected wounds had been allowed to heal completely by secondary intention for several months before nerve exploration was carried out. It is generally accepted that primary nerve suture should not be carried out in an infected field. With the employment of sulfonamides and penicillin, this opinion will undoubtedly be changed. However, Holmes and Medawar[7] have demonstrated experimentally that the instillation of large amounts of the sulfa drugs into the nerve bed produces a "toxic neuritis" from which recovery is slow. This suggested the possibility that a part of the physiologic disturbance in

6. Neurosurgery and Thoracic Surgery, Military Surgical Manual Vol. VI, page 89. Philadelphia: W. B. Saunders Co., 1943.

7. Holmes, W., and Medawar, P. B.: Local Application of Sulfanilamide to Peripheral Nerves, Lancet, Lond., 243:334, 1942.

our recently operated postinfected cases may be due to sulfonamides introduced into the wound at the time of injury and not entirely to scar tissue formation. On the other hand, Craig[8] feels that small amounts of sulfanilamide can be dusted into the wound without risk. More cases will have to be observed before the issue is settled.

When a wound has healed, the decision on the question of exploration for all types of nerve injuries is influenced by the extent of the injury, the subsidence of infection, and most important, the clinical progress. Following the last war, opinions differed about the time to wait for spontaneous recovery. The Medical Research Council of Britain[9] advocated operation after an interval of only two months if the lesion remained complete in spite of adequate conservative treatment. Foerster[10] thought that the period of delay should be from four to six months. A longer period is now generally accepted. It seems clear that to operate before five or six months may entail an unnecessary operation, and the recovery after earlier delayed operation is usually no more complete. During the period of "watchful waiting," very thorough sensory and electrical examinations must be done at regular intervals by a trained observer who has a knowledge of "trick movements" as well as of the possible variations in the normal motor and sensory supplies and the electrical reactions during the recovery phase. Electrical examination, particularly with the faradic current, is helpful in the diagnosis and prognosis of the nerve lesion. A method for measuring nerve regeneration recently used by Richter and Katz[11] is an electrical skin resistance method that is accurate, simple, and rapid but seems to be limited essentially to sensory components of nerves. Its usefulness in testing nearly pure motor nerves as the musculospiral (radial) nerve has not yet been reported.

SURGICAL TREATMENT

In all clean cases, immediate suture of the nerve ends should be done and the wound closed without drainage. In the infected cases, as seen in most war injuries, the infection must be cleaned up before nerve function can be restored. It

8. Craig, W. McK.: War Wounds of Peripheral Nerves, U. S. Nav. M. Bull., 41:613, May 1943.
9. The Diagnosis and Treatment of Peripheral Nerve Injuries, No. 54, Medical Research Council (1920), London.
10. Foerster, O.: Handbuch der Neurologie, Part 2, Sections 2 and 3, Berlin, 1929.
11. Richter, C. P. and Katz, D. T.: Determination of Peripheral Nerve Injuries by the Electrical Skin Resistance Method: Ulnar Nerve, J. A. M. A., 122:648, 3 July 1943.

is now felt that if the extent of the infection is not too great, the nerve ends can be sutured and the wound dusted lightly with sulfanilamide. Nothing is lost by so doing and much may be gained. Recent experience with penicillin shows such rapid sterilization of wounds in most instances that primary suture can be carried out very early.

In the previously infected healed cases, where there is no sign of functional recovery after a period of observation, the nerve is exposed at operation and dissected free from scar tissue. This is best accomplished under local anesthesia and by sharp dissection. The most careful handling of the nerve structure and careful hemostasis are of prime importance. The use of a tourniquet on the proximal part of an extremity is to be discouraged. After the nerve has been isolated, the question arises, "What should be done with the damaged nerve?" I think Stookey's aphorism[12] is good, namely, "Do radical nerve exploration, but do conservative nerve operation."

When the continuity of the nerve is preserved, the decision between nerve resection and some form of neurolysis may be difficult to make. The gross appearance of the nerve may be of some aid as well as palpation of its consistency in the region of the injury. In doubtful cases, sometimes judgment can be based on the electrical stimulation of the normal proximal segment. This is not entirely conclusive as it will elicit a response only in fibers which have completed their regeneration to motor end organs. A convenient adjunct that should be used in such doubtful cases is that of "internal neurolysis." This means the breaking up of the intraneural scar tissue by the injection of normal physiologic saline solution directly into the scar of the nerve. In a normal nerve, such an injection causes the nerve to swell and "balloon out" easily. In a badly scarred nerve or in a neuroma, the tissue remains "fixed" and hard and injection is difficult. When such an injection is successful, the nerve is replaced into a new bed of healthy muscle tissue and the wound closed tightly without drainage.

In the remaining cases where a hard enlarged neuroma exists or where an incomplete division with a residual fibrous band or a complete division are evident, resection and some type of plastic repair must be carried out. It must always be remembered that no matter how well a delayed repair is done, the functional results are never 100 percent.

12. Stookey, B.: Surgical Considerations of Peripheral Nerve Injuries, Surg. Gyn. Obst., 27:362, 1918.

Many ingenious methods of nerve repair were devised in the last war, the so-called "bridging operations" for the repair of "gaps" in nerve wounds. Among these are the cable graft, full-thickness graft, suture-a-distance, double lateral implantation, pedicled graft, tubular graft, and various types of nerve "flaps." Sanders[13] has shown that an end-to-end anastomosis, and in a few selected cases, the cable or full thickness grafts are the only ones that result in clinical improvement. All the rest of these should be discarded as being unsatisfactory. There are situations however where manipulative end-to-end sutures are relatively ineffectual, and in these the "bridge" operations should be used; these are, the repair of digital nerves (Bunnell[14]); in lesions of the brachial plexus where mobilization is difficult; and the repair of the facial nerve in its canal (Ballance Operation[15]).

For the selection of an autogenous nerve to be used in a "bridge" operation, Bunnell prefers to use the sural nerve taken from the calf. It leaves no appreciable disability and although purely a sensory nerve, it transmits both motor and sensory fibers as a bridge equally well. He has shown that the regeneration of nerve fibers occurs largely in the peripheral zone of the graft, while the central portion shows some necrosis. This argues for the use of several small cable grafts rather than a single full-thickness graft.

In all other situations where the nerve can be mobilized adequately, end-to-end suture should be carried out. This sometimes requires that the nerve elements be stretched in order to bring the two ends together properly. A simple method that is frequently overlooked is to suture the two scarred end-bulbs together solidly with the nerve in optimum relaxation and the extremity properly flexed, and then gradually lengthen the extremity during several weeks until maximum stretching has taken place. Then in a second operation, the nerve bulbs are resected and an end-to-end anastomosis of healthy nerve fibers is carried out. Such a "stretching process" must not exceed 10 percent of the length of the mobilized nerve since intraneural hemorrhage with subsequent fibrosis tends to occur in the proximal nerve segment. An ingenious

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13. Sanders, F. K.: The Repair of Large Gaps in the Peripheral Nerves, Brain, Lond., 65:281, 1942.
14. Bunnell, S., and Boyes, J. H.: Nerve Grafts, Am. J. Surg., 44:64, April 1939.
15. Ballance, C., and Duel, A. B.: The Operative Treatment of Facial Palsy, Arch. Otolar., Chic., 15:1, Jan. 1932.

method of bridging a gap has been devised by Bodian[16] in experimental animals. It consists essentially of a "sliding graft" made by creating a "sleeve" from the neurilemma and outermost fibers of the distal segment in a large nerve and pulling the "cuff" across the gap and suturing it to the proximal stump. He feels this works well in the laboratory but it has not been used in man. In cases of multiple nerve injuries occurring at the same level in an extremity, and where nerve stretching or transplanting is out of the question, Dandy[17] has described a technique of excising a segment of the adjacent bone to shorten the entire extremity and so enable one to perform an end-to-end anastomosis. It is now generally agreed that an end-to-end anastomosis yields the best results and should be tried in all cases.

The presently accepted technique for performing end-to-end anastomosis consists in determining the extent of the scar in the nerve to be excised and then placing two sutures as markers on each healthy segment to act as guides in preventing axial rotation of the nerve during manipulation. The scar is then excised to the level where the nerve is free of scar tissue, using the scarred portion for traction when possible. The ends to be united are cut at exactly right angles and this can be done properly only with a knife that is razor sharp. Two very fine stay sutures are passed through the epineurium only of both stumps and on opposite sides of the nerve to prevent axial rotation. Formerly catgut, number three or four zero or fine silk strands, number four or five zero, were used for this suture. Recently we have been using .003 inch diameter tantalum wire[18] that is about the size of human hair. This metal element is relatively inert and produces a minimal amount of tissue reaction. A sufficient number of sutures are than placed around the circumference of the nerve and then pulled taut simultaneously to coapt the ends.

During the past few years a type of "nerve glue" has been made from cockerel plasma or from 20 percent gum acacia (de Renzende[19]) and placed at the nerve junction to act as a physiologic bridge and so promote direct growth of

16. Bodian, D.: Repair of Traumatic Gaps in Nerve, J. A. M. A., 121-662. 27 Feb. 1943.
17. Dandy, W. E.: A Method of Restoring Nerves Requiring Resection. J. A. M. A., 122:35, 1 May 1943.
18. Fansteel Metallurgical Corp., Chicago, Illinois.
19. de Renzende, N.: Experiments on Cadaver Nerve Graft and "Glue" Suture of Divided Peripheral Nerves, N. York State J. M., 42:2124. 15 Nov. 1942.

the nerve fibers from the proximal stump into the distal nerve segment with the minimal formation of scar tissue.

When the nerve repair has been completed a satisfactory bed has to be prepared for the nerve. In the absence of a good fascial plane, this is best accomplished by placing the nerve into a plane created in adjacent muscle. We are now wrapping the region of the anastomosis in tantalum foil[18] which is .00025 inch thick and a little heavier than ordinary tin foil. This covering protects the nerve anastomosis against invading scar tissue from without, and as the metal is relatively inert, intraneural scar tissue is kept at a minimum. Experience is encouraging in the use of this metal. It does not work too well when placed at the level of a "hinged" type joint as it tends to "buckle" and the movement annoys the patient. Also, it should not be placed directly beneath atrophic scarred skin as it tends to break through the scar easily because of movement of the part. In such a situation, an adequate skin graft should be done first to replace the atrophic skin and the nerve repair carried out after the graft has healed well.

The repaired nerve is then splinted by the use of a plaster mould or cast to the extremity to promote optimum healing at rest. The principles of nerve splinting should be followed carefully. According to Highet,[20] these are as follows:

1. Splinting of nerve injuries means support of the involved parts and not complete immobilization of the entire limb.
2. A paralyzed muscle should be splinted to relax it and to avoid stretching it by gravity or by antagonistic muscles.
3. The splint must not press or rub unduly on any insensitive area of skin if trophic soses are to be avoided.
4. The splint should be so constructed as to facilitate all movements of the extremity and allow occupational therapy to be carried on.

The length of time to maintain this support depends on the extent of involvement of the limb and the rapidity of regeneration of the repaired nerve. Following World War I, the French School of Neurology set up an arbitrary sequence of signs of regeneration as they appeared to occur most commonly.[21] These are:

20. Highet, W. B.: Splintage of Peripheral Nerve Injuries, Lancet, Lond., 242:555, 1942.
21. Benisty, A.: Treatment and Repair of Nerve Lesions. Military Medical Manual, edited by E. Farquhar Buzzard, p. 69. London: University of London Press, 1918.

1. Signs of sensory regeneration appear first, as pain on pinching the skin of the involved area; pain when the nerve is pressed below the lesion; formication and spontaneous aching in muscles.
2. Signs of motor regeneration appear later, as arrest of atrophy; return of tonicity of muscles; return of faradic contractility.

PHYSIOTHERAPY

The aims of physiotherapy are to improve the circulation to the involved parts by massage and galvanic exercise; to diminish muscle wasting and fibrosis by massage; and to maintain mobility of joints by passive and active exercises. The problem of the type and amount of electrical stimulation to be used to enhance nerve regeneration after repair is still much in debate. Suffice to say, the general opinion now is that there is a definite beneficial effect on the nutrition of the limb and on its readiness to become useful once the voluntary power has returned. From the psychologic point of view its value is profound since the time required for such specialized tissue as nerve to heal requires the greatest patience on the part of both the physician and the patient.

SUMMARY

War carries with it many problems in the treatment of peripheral nerve injuries. These are being brought toward a successful solution, both by experimental investigation and practical clinical application. Histologic studies show that it is the progressive fibrosis at the myoneural junction and in the muscle that prevents full return of function after an otherwise successful nerve suture. This necessitates early nerve suture before fibrosis becomes extensive. Early nerve repair in an infected wound is now being accomplished with the aid of the sulfonamides and penicillin, both locally and systemically. So-called "bridging operations" are being discarded in preference for end-to-end anastomosis, the gap in the nerve being overcome by delayed nerve stretching, transplanting through a shorter course or even shortening the extremity by removal of a segment of bone. The nerve suture is now being done with very fine silk, tantalum wire, or "nerve glue" (plasma or acacia) in place of catgut which is being discarded because of its greater tissue reaction and scar formation. Tantalum foil is commonly employed to wrap around the nerve that has to be replaced into a scar-tissue bed.

Aerodontalgia

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The dental problems of flying personnel have been studied extensively. Tests conducted in the decompression chamber have shown that the decreased barometric pressures of high altitudes tend to produce toothache, and some individuals have reported dental pain during flights at high altitudes. Aerodontalgia, the name given to dental pain of this origin, is experienced at altitudes ranging from 8,000 to 40,000 feet. The cases studied at this station* tend to support the opinion that the pain is due to the presence of some pre-existing pathologic change in the pulp or periapical tissues.

Aerodontalgia has been found to vary in severity and duration. The altitude at which it occurs also varies. In many instances the pain has forced the individual to seek the higher pressures of lower altitudes. This is of vital importance, as is illustrated by the case of an A.A.F. pilot in a combat area near New Guinea, who on several occasions was unable to stay at high altitude because of dental pain. Fortunately circumstances permitted his descent each time. The possibilities of delay and danger in analogous situations in civilian aviation are obvious.

Aerodontalgia has been recognized for several years by individuals who have suffered from it. There is, however, a notable lack of literature on the subject. Probably the first publication regarding this matter was by H. Drefus in 1937[1] who mentioned a case and ascribed the cause to the presence of subacute pulpitis which was aggravated on ascent to about 6,100 feet. Treatment in this case consisted of a pulpectomy of the offending tooth, a lower first molar, with apparently good results.

Commander Thaddeus Joseph, et al.,[2] determined that the incidence of aerodontalgia among personnel exposed to arti-

*Randolph Field, Texas.

1. Drefus, H.: Les Dents des Aviateurs, L'Odontologie, 75:612-618, 1937.
2. Joseph, Thaddeus, Gell, Charles F., Carr, Robert M., Shelesnyak, Moses C.: Toothache and the Aviator, U. S. Naval Med. Bulletin, XLI, No. 3, May 1943, pp. 643, 645.

ficially lowered pressures in a low-pressure chamber at their station was about 1.2 percent. They gave three possible causes for the pain (1) the reaction of vital pulps of carious teeth to the change in atmospheric pressure, (2) the reaction of degenerated gangrenous pulps to the change of atmospheric pressure, and (3) the presence of a faulty inlay with a small underlying residual air space.

Armstrong and Huber after experimentation with various restorative materials, both in and out of the mouth, and with the aid of a clinical study on pilots, concluded that "Neither oxygen, cold, nor atmospheric pressure change, or any combination of these factors produced any evidence of injury to teeth or to dental restorations."

STUDY AT RANDOLPH FIELD

The majority of cases were referred to us after they encountered dental pain in the low-pressure chamber. A few were pilots who voluntarily reported to the clinic in search of the reason for dental pain which had occurred at altitudes ranging from 8,000 to 10,000 feet. The low pressure chamber is a tank-like structure large enough to accommodate several men. The temperature is kept constant within it, and oxygen is administered to the subjects above 10,000 feet. Routine "flights" are gradually made to pressures simulating 30,000 to 38,000 feet. It is regrettable that many of the pressure chamber subjects are visitors to the field for only a day, which makes treatment and subsequent observation difficult.

A complete dental history was obtained from each patient reporting to the dental clinic. For example, an individual complained of pain in the right maxillary region during a pressure chamber flight to 38,000 feet. A sudden, sharp, moderately severe pain in the R-7 area developed at about 8,000 feet; it soon became a dull ache which continued during the remainder of the ascent to 38,000 feet and during the descent to about 8,000 feet. The patient stated that similar shooting pains had been noted during the past two weeks when drinking cold water. Subsequent flights in an airplane caused this same type of discomfort to appear above 7,000 feet. The history revealed that two years previously a disto-occlusal amalgam filling was inserted in R-7, and that about six months ago a large mesio-occlusal amalgam filling was placed in the same tooth. When the filling was removed, it was noted that a pro-

tective base had not been employed under a deep cavity preparation. The vitality test of the pulp was favorable, the tooth was not tender to percussion, and the x-ray findings were negative. A temporary filling of zinc oxide and eugenol was placed on 22 December 1942, after which several airplane flights above 8,000 feet were made without a reccurrence of pain. The temporary filling was partially removed 4 January 1943 and an amalgam restoration placed over it. This patient has had no further discomfort in flying, nor in the drinking of cold water.

Symptomatic evidence, usually supported by x-ray findings, has pointed to the presence of pathology in and around the tooth in question in all cases. A study of twenty-five additional patients showed that four cases were the result of old root canal fillings. Only one of the teeth with a root canal filling had a rarefied area at the apex; in the other three the pain was well localized and severe. Four cases were due to chronic periapical abscesses, and four others to acute periapical abscesses. One of these, on R-8, was discovered following a pain noticed in the chamber, which seemed to refer to R-6. After a few days' observation, the pain localized in R-8 which had a deep cavity and became sensitive to percussion. The tooth was removed and there was no further complaint.

Thirteen of the twenty-five cases were apparently due to a subacute pulpitis under deep cavities or restorations. In two of these instances pulp exposures were detected subsequent to removal of the fillings. The exposure may or may not have been present when the restorations were placed.

The treatment resolved itself into nine extractions of abscessed teeth, the placement of seven temporary zinc oxide and eugenol fillings, and the repair of an amalgam restoration. Ten of the twenty-five patients studied had good results with no recurring pains, while fifteen of this number were not available for further observation.

It may be assumed from these cases that the only teeth which would be affected are those in which some pathological changes were present before the flight was made.

Aerodontalgia might be brought about by the lowered temperatures of high altitudes or by the inhalation of cold oxygen. The pain might be induced by permitting the oral fluids or air to reach the sensitive dentine of the walls or floor of the cavitys or by the loosening of a restoration permitting it to be

dislodged from the cavity. The author tends to agree with Armstrong,[3] since no fillings have been observed wherein there was a shrinkage.

Lipson and Weiss[4] have pointed out that, due to the valveless condition of the dental pulpal veins, the pulp is susceptible to a "black-out" during a pull up from a dive. They suggest the likelihood of permanent damage to the pulp since there is a lack of any recoil mechanism whereby recovery could be complete and rapid. This fact must be kept in mind, though it is not pertinent to our particular problem, since few men observed have been subjected to such a gravitational force, and they complained of pain only during the relatively comfortable "ride" in the pressure chamber.

ANOXIA

There is generally a congestion or inflammation in the pathologic areas, such as in the case of a subacute pulpitis. This condition, although being a defense and reparative mechanism, might under circumstances in high flying cause pain and destruction of local tissues through the acute need of oxygen. The body has many compensatory mechanisms with which to allay anoxia, but in an instance such as this there would be less chance for the blood to distribute its oxygen to the area. Then, due to the venous stasis, congestion, and lack of collateral circulation, an acute histotoxic anoxia might quickly result. It would cause pain in that area much sooner than in many other parts of the body where compensatory mechanisms could prevent it. Oxygen want, however, is unlikely since it is supplied in most flights above 10,000 feet.

Knisely[5] presented a theory with reference to the occurrence of "bends" or aeroembolism in decompression cases. It seems that subjects experiencing aeroembolism may have prolonged spasms of the arterioles of the connective tissues and striated muscles which completely shut off blood supply to the area involved for some time. This author intimates that the arteriolar constriction, which causes local anoxia, results in pain even as in a case of angina pectoris. This must be considered as a potential cause of bends and/or aerodontalgia.

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3. Armstrong, Harry G.: Principles and Practice of Aviation Medicine. Baltimore: Williams and Wilkins, Publishers, 1937.

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EFFECTS OF DECREASED PRESSURE

Nitrogen is relatively fat soluble. Areas of poor vascularity are affected sooner by nitrogen bubble formation than are the more vascular areas. The dental pulp is surrounded by hard unyielding walls of dentine and there is no collateral circulation. The periapical region of a tooth is composed chiefly of a cancellous bony matrix, and in the congestion of inflammation the blood supply is increased but it is relatively static.

Nitrogen bubbles might be released in the area from the blood and tissues when subjected to a sudden decrease in atmospheric pressure, and the slowed as well as congested circulatory system of the area may not be able to relieve the condition promptly. Bubbles may be formed to compress the nerves of the vessel walls or the dental nerve itself, thereby causing the pain. The mere formation and expansion of a bubble within or without a vessel might, by compression of local nerve tissue, cause a compensatory contraction of the vessels and, with this, start a vicious cycle resulting in local tissue starvation.

A large amalgam restoration frequently permits thermal changes to be registered on the pulp, which in turn could initiate a fatty degeneration in or around this vital dental tissue. If a fatty degeneration is in progress, an increased amount of nitrogen in solution would be evident. The confinement of the bubbles within the nonyielding cage could then easily cause the pain, by the impingement of pulp tissue. A temporary tissue anoxia thus produced might result in pain as well as a more prolonged deleterious effect on the pulp. If repeated, the pulp might eventually degenerate. According to Armstrong, gas released in the tissues appears to cause pain when confined within unyielding tissues such as bone (as in the periapical region), tendons, fascia, and nerve sheathes. Surely the dentine surrounding a root canal could be included in this category.

SUMMARY

Certain pathologic teeth, and some other teeth, cause pain in persons subjected to lowered pressures of high altitudes from 8,000 to 38,000 feet. The cause is undetermined, although it appears to be either the result of a local anoxic or aeroembolic condition or a combination of the two.

The incidence of such pain has been reported to be 1.2 percent among personnel entering a low pressure chamber at

one naval station. It seems probable that the pathology in or around a tooth will undergo progressive degeneration when repeatedly exposed to low pressures.

The vitality of the tooth with subacute pulpitis in many instances may possibly be saved, if treatment is instituted when the pain first occurs in individuals subjected to subatmospheric pressures. The term subacute pulpitis as used here refers to any pain arising from the pulp of a tooth in which the pathologic condition was not in the acute stage. No differentiation has been made between active and passive hyperemias.

The zinc oxide and eugenol treatment fillings in large caries or under large restorations has given good results in five cases of subacute pulpitis first detected in the low pressure chamber. None of these patients, however, have been available for observation for more than two or three months. The anodyne effect of the zinc oxide and eugenol, therefore, may be only a mask for further progression of pathology.

In four cases, extraction of the offending teeth relieved the individuals of further pain during subsequent exposures to low pressures. The remaining fifteen cases were either unavailable for treatment or further observation.

If these statements and assumptions are true, dental officers should thoroughly examine and treat all flying personnel. More frequent use of protective bases under large restorations cavity, or by the loosening of a restoration permitting it to be is recommended.

Only Female Anophelines Carry Malaria.—It is well known that only female anophelines carry malaria. It is also a fact that though there are about 200 species of anophelines in the world, all of them theoretically capable of carrying malaria, actually only some sixty species have ever been found to do so. Further, of these sixty species, only ten or fifteen are of sufficient importance to require measures of control. There are usually only one or two mosquitoes in each theater of malaria that are overwhelmingly and almost exclusively responsible for malaria transmission. Thus, there is quadrimaculatus in the southern United States, albimanus in South America, maculipennis in Europe, funestus and gambiae in Africa, elutus in the Near East, hyrcanus and culicifacies in India and Burma, minus in Malaya and the Philippines, and punctulatus in the southwest Pacific. No species of anopheles is linked with any one species of plasmodia; that is, an anopheline can serve equally well as vector for vivax, quartan, or falciparum infections.—Hudson, Ellis Herndon, Lt. Comm. M. C., U.S.N.R.: The Malaria Problem, M. Clin. No. Am., 27:1422, September 1943.

Psychiatric Experiences in a Tropical Theater of Operations

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The care of psychiatric patients in mobile installations[1] under combat conditions is precarious but must be undertaken when the tactical situation makes rapid evacuation difficult. The cases on which this review is based were observed in two areas in a theater of operations; some occurred on an occupied island, but a larger number occurred under combat conditions on a tropical island. The threat of invasion made tension in the occupied area high at first; later, living conditions improved and except for the isolation they were similar to those of semi-garrison life. In the combat zone, in addition to the dangers of jungle warfare, there were the trials of tropical weather and tropical diseases.

The troops were well-trained National Guard regiments from widely separated parts of the United States. Generally, the incidence of psychiatric cases was inversely proportional to the military rank of the patients. About 50 percent of the troops had no psychiatric interviews prior to induction. In considering the following data, it should be understood that although cases in the noncombat area were well studied, they did not comprise a large group. The larger number of patients seen in the tropical zone included all psychiatric cases developing in a two-months period of combat. Unless otherwise stated, the cases were received at the hospital during active combat and for a seven-day period thereafter. Observation was necessarily brief, averaging about four to five days, and there was opportunity to obtain only a superficial clinical picture. Little insight into underlying unconscious motivation was obtained; however, the various responsibilities for the patients' welfare (clothing, housing, feeding, etc.) led to more intimate contact with them each day than is usually possible in civilian hospitals.

1. The patients were treated in a clearing station which normally does not care for such patients.

CLASSIFICATION OF CASES

Noncombat zone. In this zone, the psychoses were relatively more common, due in part to the fact that unit medical officers had ample time to care for many of the psychoneuroses. Sexual perversion, alcoholism, and psychopathic personality were also more common in this area. In contrast to the combat zone, neurasthenia was much more common than anxiety neurosis.

Combat zone. In two months of combat, about 2.4 percent of the entire command became ill with some psychiatric disorder. The psychiatric cases were grouped indiscriminately with either "diseases" or "battle injuries." About 6.5 percent of all types of casualties were psychiatric. A more significant figure is that giving the relation of psychiatric cases to battle injuries. About 31 percent of battle injuries were psychiatric casualties. Psychoneuroses were nearly six times as frequent as the psychoses. Physical disease, combined with the difficulties of military operations in the jungle, was so important that it was necessary to classify nearly one-fourth of all psychiatric cases in a separate category which we called "psychoneuroses associated with physical disease." It was impossible to decide, in individual cases, to what extent physical disease was a factor. Cases were included here if the symptoms were considered partly psychogenic and yet there may have been present physical disease capable of accounting for some of the symptoms. When physical disease was thought to be totally responsible or coincidental, the case was not included. These decisions were always made rapidly.

Psychoneuroses. About 75 percent of the psychoneuroses were anxiety states. There was a simple type which did not differ from the usual anxiety state. Following prolonged exposure to fighting an unseen enemy, seeing comrades killed, being "pinned down" by machine-gun fire, or undergoing the constant noise of artillery, men became tense, sleepless, hypersensitive to noise, had night terrors, and finally were unable to continue fighting or became disturbing to their comrades. A soldier after leaving the trenches because of this condition was returned after a brief rest. He soon became so agitated again that his comrades requested his removal and that he be not returned.

A second group comprised those whose anxiety was accompanied by gastro-enteric symptoms, chiefly vomiting, accompanied by weakness. A patient after enduring enemy

mortar fire for days, suddenly after a nearby mortar explosion became tense and began vomiting. An infantryman, aiding as a litter bearer, became weak and began vomiting while carrying dead bodies. Both were very tense for a few days, in the hospital, but vomiting ceased and one was returned to duty while the substitute litter bearer had to be transferred to a noncombat service group.

Another group comprised those in whom excitement or panic was outstanding. A 24-year old man told a common story. He vividly described being "pinned down" several hours by "mortar shells bursting all around"; then his buddy was killed and, as he said, "I went to pieces, I guess. I cried and shook." Five days after admission, he still was jumpy at sudden noises, but two days later he was returned to duty. The statement "How can we shoot them if we can't see them?" became a cliché, an expression of anxious frustration excitedly shouted by many patients on their first interview. Some of the excited patients were the "trigger-happy" type who saw and shot at more snipers than actually were present. In some, seeing snipers in the jungle seemed to be a hallucination; yet these patients had no other psychotic symptoms and in nearly every case were returned to duty. Such excited shooting is probably similar to that of airplane gunners who sometimes burn out their guns because they "freeze" to the triggers, firing long after the enemy plane passes out of range. Some patients exhibited "dazed" or "confused" states. A corporal twice cried while under fire. He left the lines but soon quieted and returned. Later while under heavy artillery fire, he became weak but refused to go to his battalion aid station. His comrade noticed that the corporal pulled the pin out of a hand grenade and looked at it blankly but did not throw it. He was warned and sent to the hospital where he complained only of weakness and lack of appetite; his responses were slow and vague, but he recovered in a few days. A private first class under prolonged heavy fire became "maudlin and hysterical" during an air raid. In the hospital, he showed no excitement but marked vagueness about his symptoms and he had a feeling of confusion and partial amnesia. His answer to all questions was "I don't know." On the second morning after admission he awoke feeling entirely well and pleaded to be returned to duty. When asked what had happened, he said, "I've been on the island three months. I just had a good cry

and now I'm all right. I had all that inside of me and once it came out I was all right."

Although these types of anxiety have been separated, they often were not clearly defined or were mixed. The clinical picture frequently changed rapidly from one type to another, that is, from an excited to a confused-like state, and they usually recovered quickly. Individual reactions to anxiety varied. A rifleman collapsed and vomited while carrying a litter. In the hospital he was very tense, hypersensitive to sudden stimuli, cried easily, and repeatedly said that he was unable to keep thoughts of dead buddies out of his mind. Four days later he was improved but still tearfully wrung his hands, begging not to be sent back. The chaplain was requested to see this patient, and immediately afterwards he came to the writer asking to go back to duty. An intelligent infantry sergeant said he wanted to "stay in there as long as I could" but he became tense, sleepless, and cried. He felt unable to proceed, because "I thought I'd lose my mind." He returned to duty after six days in the hospital and had remained with his outfit at least three months when the writer last heard of him.

Reactive depressions were rare. A sergeant had been on "a drive" for three days when his lifelong friend was killed in action. He became tense, seclusive, underactive, sleepless, and cried. He insisted he was well. He felt guilty about being in the hospital. In a week, after improving, he said he had not realized the severity of his mental disorder. A private first class was on patrol the day before admission when a friend was killed beside him. Crying, he carried his friend to the aid station. Later that day, he showed similar grief when two other comrades were killed. In the hospital, he cried bitterly. Eight days later he returned to duty. In many cases uncontrollable crying was a prominent symptom. However, it was not so much related to the precipitating incident as in the case described above and was accompanied less by subjective depression than by tension. Identification with a comrade who had been killed likely was responsible for the grief in most cases.

Hysteria, such as fugue states, motor paralyses, tics, and anesthesia accounted for about 7 percent of the psychoneuroses. Because of inadequate information, it was difficult to distinguish hysterical fugue states from postcerebral-concussion amnesia, and the anxiety states in which amnesia seemed

to be partial ("excited" or "pseudo-confusion" types of anxiety described above). Neurasthenia was a little less frequent than hysteria. Only one case of hypochondriasis was seen and this was chronic. The remaining 10 percent of the psychoneuroses were unclassified or mixed.

Psychoneuroses associated with physical disease. Malaria and physical exhaustion, as far as physical disease was concerned, about equally accounted for 70 percent of these cases. The remaining were found among cerebral concussions, upper respiratory infections, and functional vascular disturbances—tachycardia, hypotension, hypertension, and neurocirculatory asthenia. Most of these functional disturbances could not be adequately studied; there were, therefore, diagnostic errors. Cases were included in this group if the subjective symptoms were correlated with a systolic blood pressure under 100 for at least two days and then became higher, if the pulse rate exceeded 110 for the same period, or if the systolic and diastolic blood pressures exceeded 150 and 100 respectively. Only ten cases were included in the functional vascular disturbances.

Psychoses. Nothing was remarkable about the psychoses, although there was affective coloring even in the schizophrenic-like states. The only alcoholic psychosis showed marked affective features (rage), and the psychoses with psychopathic personality showed behavior similar to hypomania. One case of psychotic depression was known to the writer for months prior to his breakdown. He was an irritatingly aggressive individual, who maintained a superior attitude. He received, therefore, a great deal of "riding" from other soldiers. There was frustration, also, as far as promotion was concerned. Finally, he became seclusive, spent all day in bed, and refused to eat or do more than care for a minimum of physical needs. His psychosis developed about the time that combat ceased. Another questionable depression accompanied by accusatory, auditory hallucinations has been more accurately described as a guilt-psychosis.

Psychopathic personality. A group of cases was characterized by chronic emotional instability or insubordination and poor discipline. Two schizoid personalities were included here.

Malingerers. Only 0.6 percent of all psychiatric cases were definite malingerers. After a warning, all but one returned to duty and did not re-enter the hospital. This soldier failed to take atabrine and became ill with malaria. He was court-

martialed. There were five times as many additional cases who were not officially classified as malingerers in whom it was strongly suspected that the symptoms were being exaggerated. They were warned, and they did not return to the hospital.

Mental deficiency. Inadequate time for examination and the use only of rough testing undoubtedly led to an underestimation of the incidence of mental deficiency.

TABLE I

Psychiatric cases in combat zone

Psychoneuroses	59	percent
Psychoneuroses with physical disease	27	"
Psychoses	9	"
Psychopathic personality	3	"
Malingerers	0.6	"
Mental deficiency	1	"

PRECIPITATING FACTORS

Noncombat zone. The precipitating factors seemed similar to those producing emotional upsets among soldiers recently separated from previous occupations or bored by the routine of Army life. Failure to be promoted, inability to have completed an education, quarrels, and difficulties at home seemed important. The tedium of routine and discipline with inadequate emotional outlets accounted for sexual perversion and alcoholism in the noncombat zone. In the combat zone, fear and fatigue prevented such perverted activity. Guard duty at lonely outposts when invasion was considered imminent was uniquely important in the onset of two psychoses, one a psychotic depression, the other paranoid schizophrenia.

Combat zone. Moving from a noncombat zone into combat entailed factors other than fear of death. Morale was actually improved. Movement even into combat meant release of emotion, freedom from the guilt of being overseas unengaged in combat, and a chance to get the job over with at any cost. The ancient glory with which history has surrounded the soldier going into battle was a stimulus. The protection of loved ones and the herd or social obligations were always in the background. Breakdowns were not likely to occur on first contact with the enemy but only after repeated fear-producing stimuli; i.e., after the accumulation of anxiety. Fear of the unseen arose not only from an invisible enemy and booby-traps, but from malaria-carrying mosquitoes. Artillery fire at

night, terrific downpours of rain, pruritus, slow-healing sores, and the omnipresent ant caused irritability and loss of rest. Other physical factors in the genesis of mental disorder were fatigue, malaria, atabrine, intoxication, excessive heat, and sulfathiazole (one case). Alcohol played a very little part in the combat zone.

Emotional tension was increased by many factors in front-line combat. Particularly destructive of morale were aerial bombings, especially on rear-echelon installations, mortar fire, and noise from antiaircraft guns. Loud noises embodied the elements of suddenness and the panic of not knowing at once whether it represented enemy or friendly fire. Vibration of the ground and the physical impact of the blast of air heightened the stimulus. Antiaircraft gunners presented difficult prophylactic problems. Night noises present a special problem. A soldier learns to become fully alert when awakened by noises at night. Because of the light sleeping thus conditioned, insignificant night noises keep the soldier awake and fatigued.

Unfulfilled desire for promotion was a factor. Morphine often caused prolonged nausea and vomiting difficult to control. Patients who are exhausted or emotionally upset frequently are strongly predisposed to vomiting.

Although the significance is not clear, only three manic depressive psychoses, manic type, occurred within the entire period of combat. Four other cases began within a few days following cessation of combat, and an additional case, not included in the above figures, occurred ten days after cessation of combat.

A young college graduate, who had majored in premedical work had during combat become disoriented. Unnecessarily he exposed himself and his men to danger. By the time he reached the hospital he was calm and complained only of total amnesia for events prior to his breakdown. Under intravenous barbiturate anesthesia he recalled a few facts about his past. He suddenly while speaking of another topic asked, "Why am I not interested in women like the others?" Though this man was later put on a special rear-echelon detail, he recovered little of his memory and it was necessary to evacuate him. The effect of anxiety in the exacerbation of a compulsive obsessive neurosis was shown in a young, sensitive artist who had for a year prior to entrance into the Army suffered from a compulsion to touch various objects. He told of his symptoms

with great embarrassment. They had become slightly more severe in the Army, but not until he reached the front lines did they become incapacitating. One night in the trenches he was observed by a soldier near him compulsively touching the walls of the trench. The patient stated he was brushing off ants; later he asked to be taken out of the lines. He found himself pointing a gun at his fellows. The patient stated he was afraid he might shoot one of them.

Lack of will-to-recover was an important factor in the ultimate recovery of patients. Though able to measure only roughly the unconscious levels at which psychologic mechanisms occurred, the fact is that "secondary gain" seemed no more predominant among patients with purely psychiatric disorders than among other types of patients with distressing or uncomfortable symptoms. On the other hand, it is well known that soldier-patients with physical disease are not likely to develop psychoneurotic symptoms; this refers only to severely and acutely ill patients who by their illness are honorably freed from danger. It is a very different matter with chronic or mild physical disease having ill-defined symptoms in which there arise the conflicting elements of guilt on the part of the patient, indecision on the part of the medical officer, and the opportunity to contemplate the advantages of being in a comfortable hospital. These well-known facts are mentioned because of the misunderstanding and suspiciousness of psychiatric disorders occurring in combat, prevalent among most line officers. The effect of preinduction psychiatric screening on the breakdowns could not be accurately observed. Since only about 50 percent of the troops from which patients were drawn had psychiatric interviews before induction, the writer does not feel that intensive screening is necessary. In general, the impression was acquired that definite psychopathic personalities and those who had previous mental breakdowns were the major problems and should have been eliminated. More study of this particular group of soldiers is indicated since they were only partially screened.

TREATMENT

The patients were housed in tents. All interviews were held in a separate tent at a distance from the wards. On admission to the hospital, efforts were directed toward reassuring patients and making them comfortable. Their quarters were kept orderly and clean. Adequate washing and bathing

facilities were available, an important consideration in the care of men who have been living in jungles. The usual drug sedation was used. Occasionally sheet restraints were necessary. When possible, patients were kept busy at simple but organized work about the hospital. A separate service group working at various rear-echelon details under the supervision of the division headquarters company was formed. The latter project was highly successful. The realization that psychiatric disorders were not totally disabling was of great value not only to patients but to potential patients.

They were treated in a sympathetic, yet matter-of-fact fashion, at frequent (daily when indicated) psychotherapeutic interviews. Reassurance is doubly effective if the doctor knows what he is reassuring the patient about. Transmission to the patient of the feeling that everyone in the Army has difficult, but necessary, problems gives him a strong feeling of solidarity, of belonging to a special group.

One most important aid in treatment and prophylaxis was the assurance given to patients that they were not going to be evacuated from the island. To quiet psychotic patients they were often told that they were going to be evacuated immediately, and this was accomplished as quickly and as secretly as possible. No other patients were told they were going to be evacuated before they were actually sent out. The duty of the medical officer doing psychiatry in a 2d echelon medical installation was primarily to sort patients and to send as many as possible back to duty. It was found moreover that overhospitalization was more disastrous to the chances of recovery than too early return to duty.

Hysteria is a special problem with a specific therapeutic technique. Complicated gadgets and fixed rituals are unnecessary and often a detriment. Patients were treated at once, but only after preparation by strong suggestion. Intravenous barbiturates were used but the treatment was varied depending on the credulity of the patient. One man, fatigued, suddenly became unable to use one leg. He believed the origin of his trouble lay in his buttock. Examination revealed only diminished sensation over the paralyzed leg. Two cc. of paraldehyde given into the gluteus maximus produced the usual local pain. The pain was suggested to be moving down the leg, a belief which apparently was readily accepted by the

patient, and by the time it reached his toes he was able to move them. Hysterical anesthesiae were best removed by suggestion and repeated painful subcutaneous saline injections over the involved area. Face-saving procedures were carried out chiefly by removal of the patient to another ward after treatment and by maintaining a helpful, sympathetic attitude among the attendants.

Disposition. Only 6 percent of the psychiatric cases, returned to duty, again re-entered the hospital; nearly half of these were returned to duty a second time; about one-third are now permanent members of a rear-echelon service group, and about 15 percent were evacuated. One-third of the cases first assigned to the provisional service group later required evacuation.

In the combat zone, 55 percent of the psychiatric cases were ultimately returned to duty, 22 percent required evacuation, 10 percent became permanent members of a rear-echelon service group, and 13 percent still remained in the hospital when the period over which cases were studied was terminated. Since then, all cases in the hospital have been discharged. The corrected figures, therefore, are as follows: returned to duty with original unit, 61 percent; service group, 10 percent; evacuated, 29 percent. In addition, the figures for the number of psychiatric patients evacuated can be lowered if one does not include those evacuated for administrative reasons or because of recurrent malaria.

SUMMARY

A review has been presented of psychiatric patients treated in 2d echelon medical installations. Care of this type of patient was possible only because of the unusually static nature of the combat. A striking contrast was noted between cases seen in the period of occupation and those seen in actual combat. A tentative subdivision of the anxiety states is presented. Sexual perversion and alcoholism were more common in the semi-garrison zone. Physical disease was very largely contributory to mental disorders in the tropical combat zone and frequently could not be distinguished from them. Malingering was rare. Lack of time for complete studies in the combat zone probably led to diagnostic errors, such as underestimating the presence of mental deficiency, psychopathic personality, and cerebral malaria. Lonely outpost duty, excessive use of morphine as a sedative, clever camouflage by the enemy,

and difficult terrain, the tropical weather, and tropical disease were important precipitating factors. Treatment depended largely on routine simple work in rear echelon areas, reassurance, and sedation. Anxiety as well as hysteria, because of the problem of secondary gain, are emergencies best treated as quickly and as near the front lines as possible. An important measure in curing as well as preventing many breakdowns and recurrences was the fact that patients were told they would not be evacuated. In a closely-knit fighting organization, such information spreads rapidly, and soldiers are very sensitive to Medical Department policies.

The Treatment of Fulminating Meningococcic Infections

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Experience in the treatment of meningococcic infections among troops in the southeastern states during the past winter has shown that early, properly administered treatment with one of the sulfonamides is successful in all but the most fulminating cases.[1] In 1,935 cases which occurred between 1 December 1942 and 25 June 1943 there were 64 deaths. Of these 64 cases, 11 received no serum or chemotherapy and 10 were treated one to three hours before death at a time when treatment could hardly be expected to alter the course of the disease. Thus the over-all mortality was 3.3 percent while the therapeutic failures constituted only 2.2 percent. Of 49 cases that have been examined post mortem, 20 revealed hemorrhages into the adrenal glands. The necropsies were performed in various laboratories throughout the Fourth Service Command and the sections were reviewed at the Army Medical Museum.[2] It is with the rationale of treatment of such cases that this presentation is chiefly concerned.

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1. Thomas, H. M., Jr.: Meningococcic Meningitis and Septicemia, J. A. M. A., 123:264-272, 2 October 1943.

2. Haymaker, W. E., Custer, R. P., and Thomas, H. M., Jr.: The Pathologic Findings in Forty-Nine Cases of Meningococcic Infection, in preparation.

Captain Webb Edward Haymaker assisted with the manuscript and reviewed the pathological material which forms the basis for the preliminary statements.

Due to lack of space, the tables have been omitted.

When subdivided according to amount of blood extravasated into the adrenal gland tissue, the 20 cases fall into three groups: 6 in the severe hemorrhage group, 7 in the moderate hemorrhage group, and 7 in the mild hemorrhage group. Table I shows the salient clinical features presented by the three groups. All but two of the patients showed purpuric skin lesions in addition to the usual petechiae. In most cases these lesions increased in number and extent while under observation. The blood pressure was measured in 19 cases and found to be low or unobtainable in 15. The range was 80/50 to 52/22 in most of these cases. In two cases where a normal reading was recorded it was noted that the patient's pulse later became feeble and too weak to count which strongly suggested a fall in blood pressure. Cyanosis was present in 6 cases. Leukocytosis, averaging 19,000 in the group that died early, rose abruptly to high levels (as high as 73,000 and averaging 38,000) in cases which lived a day or two longer. Fever on admission to hospital ranged from 99° to 104° and rose or fell as exitus approached. Eleven patients were comatose or semicomatose, 10 were extremely restless and delirious, and 4 were conscious to within a few minutes of death. The cases in the severe hemorrhage group differed strikingly from those of the other two groups. Those patients with severe hemorrhage lived an average of only three hours after admission to the hospital, whereas the others lived an average of thirty-six hours and thirty-eight hours respectively. Moreover those with severe hemorrhage who died early showed little or no microscopic evidence of myocardial, renal, or cerebral lesions, while of those in the moderate group, 4 showed edema and focal interstitial myocarditis, 2 showed renal changes characteristic of shock, and 5 out of 7 had collections of fluid in some or all of the serous cavities. It seems reasonable to suppose that cases in the severe hemorrhage group suffered from a more overpowering toxemia which caused death before cellular changes could become manifest or effusions develop. In only 4 of the 20 cases was there clinical evidence of meningitis. In addition to these in 6 others there was pathological evidence of early meningitis. The meningococcus was isolated in 18 cases.* Group I, 6; group IIA, 3; group II, 1: not typed, 8.

*Several cases of fulminating meningitis without hemorrhage into the adrenal glands died within an hour of admission to the hospital.

The problem of therapy in such cases resolves itself into measures for combatting the various clinical phases of the disease; namely bacteremia, toxemia and shock.

BACTEREMIA

From results obtained in the (97 percent) cured cases of meningococcus infections referred to in the opening paragraph, it is clear that the early intravenous use of from 3 to 5 gm. of sodium sulfadiazine, followed by oral or venous administration of the drug in doses adequate to maintain a blood level of from 10 to 15 mg. percent, will provide an adequate amount of antibacterial agent. Many of the cases which appeared to be extremely ill showed marked improvement within twenty-four hours of chemotherapy and fluid replacement. Intravenous doses of 5 gm. of sodium sulfadiazine in 100 cc. of distilled water were frequently followed by hematuria, gross or microscopic, unless they were preceded or accompanied by the administration of a liter of normal salt solution. Sixth molar sodium lactate by alkalinizing the urine and thus further reducing the drug crystaluria, seems even more effective in this regard. Frequent blood level determinations during the first twenty-four to forty-eight hours will govern the amount and frequency of drug therapy.

TOXEMIA

Toxemia in these cases is of such severity that purpuric hemorrhage occurs in the skin and other organs throughout the body. Toxemia in these cases may be of such severity that death may take place as early as three hours after the soldier reports feeling ill. Toxemia in these fulminating cases may even be increasing dangerously in the first few hours of chemotherapy. If there is a possibility of combatting this toxemia, every effort should be made to do so. Meningococcus antitoxin offers a means of attempting to accomplish this. Throughout the Fourth Service Command 134 cases were treated with antitoxin and probable benefit was reported by 15 different observers in 56 cases. In several instances patients in coma became conscious in an hour or two after receiving antitoxin and in many others clinical improvement was thought to depend, at least partially, on the action of antitoxin. Since only one to two or three fulminating cases occur in any one hospital, it is difficult to evaluate various types of therapy. It must be remembered that individual clinical impressions are proverbially unreliable. Thus our clinical observations in these 56 cases

are to be taken as merely slightly encouraging. A method of measuring toxin-neutralization may help to determine the therapeutic value of antitoxin.[3] Concentrated rabbit anti-meningococcus serum which is being prepared is said to contain ample antitoxin as well as other antibacterial properties. This form of serum will be available in quantity in the near future.

From the above remarks it becomes clear that antitoxin should, if given at all, be given early and in adequate amounts, care being taken, of course, that all the precautions necessary in any form of intravenous serum therapy are observed. Antitoxin should not be withheld while possible improvement from chemotherapy is awaited. Prompt neutralization of the toxin may prolong life and give chemotherapy the chance to rid the body of the organisms. Some hesitancy may be felt by medical officers early in their experience with meningococcus infections in making the diagnosis of fulminating meningococcemia without bacteriologic confirmation. It will be found in Army hospitals, especially during an outbreak of meningitis, that the diagnosis is readily made from the clinical findings alone. Occasionally a case of heat stroke (which usually can be excluded by the lack of history of exposure to undue heat and humidity) might be confused with fulminating septicemia. Purpura haemorrhagica should not cause confusion. The meningococcus is the cause of septicemia in nearly every case which does not present some primary focus of infection. In cases showing purpura, early coma or marked restlessness, and leukocytosis treatment for meningococcus infection should be started within the first few hours in the hospital.

This phase of serum therapy in meningococcus infections deserves further development since, at present, current opinion loosely groups all forms of serum therapy together and holds that serum therapy is rarely necessary and then only if chemotherapy has failed. For instance, one opinion is, "The addition of specific serum therapy to chemotherapy does not appear to influence the course of the disease."[4] It seems quite clear, however, that the antitoxic effect is necessary only in the fulminating type of case under consideration in this discussion.

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4. Kuhns, D. M., Kisner, P., Williams, M. P., and Moorman, P. L.: The Control of Meningococcic Meningitis Epidemics by Active Immunization with Meningococcus Soluble Toxin; Further Studies, J. A. M. A., 110:484-487, 12 Feb. 1938.

SHOCK

Low to imperceptible blood pressure was found in all but four of the 20 cases. In cases which are commonly alluded to as Waterhouse-Friderichsen syndrome, it is generally believed that the fall in blood pressure is due to sudden incapacitation of the adrenal glands by hemorrhage. Suggestion for replacement therapy rests on this hypothesis. A fall in blood pressure may occur, however, in the absence of hemorrhage in the adrenal glands. There were, in fact, three cases in this series of 49 fatal cases which were clinically indistinguishable from Waterhouse-Friderichsen cases. One showed increasing purpura, the other two extensive petechiae, all showed low blood pressure and leukocytosis and at necropsy there were hemorrhages in many organs and yet none in the adrenal glands. Little clinical difference could be seen between cases in which large portions of the cellular structure appeared normal and others where most, if not all, of the gland was a "sack of blood." Therefore, it seems equally rational to view hemorrhage as an index of severity of the "toxemia" and hemorrhage in the adrenal glands as a result of the "toxemia." Injury to adrenal cells can be demonstrated in patients dying from various infectious diseases and this lesion may be significant although the part it plays among the many possible causes of death remains uncertain. One cannot ignore the possibility in recovered cases of late symptoms arising both from "toxic" and hemorrhagic lesions of the adrenals. It seems probable, in fact, that they may be the cause for the later development of some of the otherwise unexplained cases of Addison's disease.

Treatment of this particular form of shock (i.e., shock occurring in the course of an infectious disease) whether or not there may be lesion in the adrenal glands must be guided by several principles. In the first place "toxemia" sufficient to induce profound shock is capable also of producing cerebral edema and focal interstitial myocarditis. Because of such changes caution should be exercised in administering fluids. Plasma may be given intravenously (500 cc.) and can be repeated in four hours if a state of shock persists. Normal salt solution given intravenously should be restricted to 1,000 cc. twice each twenty-four hours. If, as so often happens, pulmonary edema is present, 500 cc. of 1.5 percent saline to which has been added 25 gm. of glucose can be substituted. In cases of this variety intravenous fluids should be given slowly. In

the second place, suprarenal cortical extract may be employed regardless of the mechanism underlying the shock.[5] Suprarenal cortical extract if used should be given in an adequate dose (30 cc.) injected intravenously. This program is different from one of adrenal replacement therapy. Ten cc. may be given every six hours thereafter if indicated. There is little or no evidence that desoxycorticosterone plays any worthwhile role in the control of acute shock, once the shock has been established, nor would it be expected to act in the acute phase of replacement therapy as well as suprarenal cortical extract. In addition there are some dangers connected with its use. The use of adrenalin in the treatment of shock is generally considered contraindicated but an occasional 0.5 cc. dose has been thought helpful by some clinicians.

In order to carry out treatment intelligently, it is necessary to keep two hourly records of blood pressure, pulse rate, urine output, and the presence or absence of pulmonary edema. An effort should be made to maintain the blood pressure between 90 and 110 mm. of Hg. Urine should be excreted (after shock has been relieved) at the rate of 50 cc. an hour the first day, and 65 cc. an hour thereafter. If the patient fails to void catheterization becomes necessary. Urinary output is one guide to the regulation of fluid intake, but the state of the circulation must be considered at all times.

As soon as the clinical diagnosis of fulminating septicemia, presumably meningococcic, is made some such program of treatment as the following should be instituted:

Record blood pressure, pulse, pulmonary signs, urine.
0-20 min. 1,000 cc. Molar/6 Sodium lactate I.V.
0-40 min. Test for serum sensitiveness.
20-40 min. 100 cc. 5 percent sod. sulfadiazine in distilled water I.V.
40-70 min. 30,000 units of meningococcus antitoxin I.V.
70-110 min. 500 cc. plasma I.V.
Record blood pressure, pulse, pulmonary signs, urine, blood level of sulfadiazine.
110-160 min. 1,000 cc. normal salt solution I.V.
160-180 min. 30 cc. suprarenal cortical extract.
Record blood pressure, pulse, pulmonary signs, urine, blood level of sulfadiazine.

All the medication can be given through the same intravenous set clearing the tubing before and after sodium sulfadiazine with 50 cc. of distilled water. Sedatives are required

5. Banks, H. S., and McCartney, J. E.: Meningococcal Adrenal Syndrome and Lesions, Lancet, Lond., 1:771-775, 19 June 1943.

in many cases and paraldehyde has been used successfully by many physicians. After the first three hours of treatment the various preparations listed above are to be continued as indicated according to the principles outlined in the text of the paper.

DISCUSSION

The number of cases of so-called Waterhouse-Friderichsen syndrome that have responded to this program or some modification of it is, of course, not known, but on clinical evidence alone it is believed that there has been a fair number. In reviewing protocols of other cases published as cures, one is struck by the fact that great emphasis has been placed on a day or two of adrenal replacement therapy which has been assumed to be adequate to relieve the adrenal insufficiency. Acute and very temporary adrenal insufficiency caused by extensive hemorrhage, or by necrosis, can be assumed to occur, but it seems safer and more practical to treat the individual as a whole rather than to attempt to combat the results of a single pathological lesion which, to say the least, has not been clearly defined. Supportive and shock therapy undoubtedly do play large roles in the cure of these cases. Any one individual's experience, however, is limited to a case or two. In a given military area preparation for uniform study and treatment of this particular type of case will doubtless provide further important information.

In the meanwhile the decision to use meningococcus antitoxin and suprarenal cortical extract must not detract attention from other procedures of fundamental importance; namely, (1) prompt diagnosis; (2) immediate and careful intravenous sulfonamide treatment; (3) attention to control of fluid intake and output and maintenance of electrolyte balance; and (4) treatment of shock.

CONCLUSIONS

Chemotherapy of meningococcic infections is successful in the majority of cases. Rare fulminating cases of septicemia are encountered which are characterized by purpura and shock. The underlying mechanism in such cases has been discussed in the light of present knowledge and the rationale for treatment outlined.

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Veterinary Service in Iceland

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In August 1941 orders came for a veterinary detachment to accompany the unit that was to establish the Headquarters of the Iceland Base Command. Thoughts of perpetual snow and zero temperatures were in our minds, but a great surprise was in store. On landing, the countryside was a brilliant green with luxurious grass which is cut several times a year to provide feed for the livestock. The capital, Reykjavik, is a city of 40,000 persons, most of whom have houses of concrete and corrugated iron. The 112,000 inhabitants of Iceland depend mainly on fishing and agriculture for a livelihood.

The veterinary detachment immediately began the inspection of the troops' food which, during the early part of the occupation, came mostly from cans. The only fresh foods were lamb and fish purchased locally. Slaughtering is carried on immediately after the sheep are collected from the mountain slopes and sorted. The roundup occurs about 21 September and from then until Christmas the young sheep are killed for market. The lambs were inspected before, during, and after slaughter. All carcasses are frozen immediately and stored until sold. The Icelandic lamb has a much stronger flavor than the American.

The waters around Iceland abound with fish. The bay at the southwest corner of the island is full of cod, halibut, flounder, and plaice. In waters to the north are great beds of herring and nearby are large herring-oil factories. Herring-bone meal is used to supplement the ration of the livestock. Herring fishing is at its height in July and August. The salmon which are caught in most of the streams weigh from 10 to 14 pounds. The trout are sometimes called salmon trout because of the red color of the meat.

In commercial fishing, the fish are cleaned before being brought to shore. The livers of the cod are cooked on the trawlers and the crude oil is taken to refineries where commercial cod-

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The milk situation in Iceland will be discussed in another paper by the author.

liver oil is produced. The fish companies employ women filleters. The fillets are packed into units of seven pounds each and wrapped in parchment. The U. S. Army bought mainly frozen cod. Icelanders eat little frozen fish. Sanitary supervision was carried on at the fish establishments, which cooperated fully in improving sanitation. Modern quick-freezing equipment has been installed. As frozen meats and dairy products were brought in by the Navy, fresh fruits and vegetables also were frequently available. Veterinary inspectors boarded the supply boats on arrival. Supervision over methods of handling, of vehicles used for the transportation of these items, and of storage places was maintained. Veterinary personnel was present at the quartermaster supply depots at all times to check food products when issued.

Very little meat and dairy products spoiled during trans-Atlantic shipment or during storage in Iceland. Warehouses containing nonperishable food were visited each month, in company with a representative of the quartermaster, to check the proper turnover of stock in storage.

During the slaughtering season, while inspecting lambs, we met the Icelandic state veterinarian. He spoke some English and before long a picture of the livestock troubles was acquired. The dairy cattle had never been tested for Bang's disease. Through him, American veterinarians became acquainted with the local agricultural problems. The government veterinarian was interested in starting a testing program for tuberculosis and Bang's disease. He arranged a conference with the Secretary of State to discuss a program of this kind. The Prime Minister, who was also Minister of Agriculture, keen on improving the health of livestock, arranged for space for a veterinary laboratory in a modern laboratory building of the University of Reykjavik. The directors of the Institute of Research and the head of the pathology department of the Medical School provided a small amount of equipment for the laboratory, some supplies were obtained from Army medical units, and the remaining needs were requisitioned from the United States. The laboratory began operation in the spring of 1942.

A delicacy provided for the troops was American ice cream. An enlisted man of the veterinary detachment of the quartermaster refrigeration company worked out an excellent formula using the dehydrated items available. The mix was made in forty-quart milk cans which were placed in a large vat of water

heated by steam and thus was pasteurized by this arrangement. A small electric freezing unit was used by one depot. The Army jeep has been used for almost everything. To add to the accomplishments of this twentieth-century marvel, one depot used a jeep to run the ice-cream freezer.

The Icelandic pony is a bit larger than the Shetland pony. The Army veterinarians gave professional aid and advice to the Army Winter Warfare School in purchasing, caring for, and feeding the pack ponies. Another duty was the examination and treatment of the sentry dogs. Army veterinarians were used also to investigate claims against the U. S. Government by the natives for accidents involving their livestock. As liaison between the Army and the local government, the veterinarians supervised, within the Army, the restrictions of the Icelandic laws relative to the control of animal diseases. The base veterinarian was responsible for keeping the surgeon and commanding general informed of the presence of diseases transmissible from animals to man.

As agriculture is the chief occupation, the Veterinary Corps had an extraordinary opportunity to be of service to the Icelandic Government. The sheep are troubled with several serious diseases which kill thousands of animals. It was proposed to cooperate with the research committee in an investigation of the difficulties. The veterinary section, with the approval of the commanding general and in cooperation with the local government, including the Office of the Minister of Agriculture, Icelandic Agriculture Society, the Research Board of the Medical School, the Milk Control Board, and the native farmers and veterinarians, helped to investigate some of the problems of animal husbandry, milk production, and disease control. Several thousand cattle were tested for tuberculosis and Bang's disease between September and May, during which period the cattle are in the barns. The hours available for work during the day varied with the season. The long nights left a short period of daylight in which to travel and work, of which only about four hours could be spent in testing. In the late spring there was little darkness and occasionally veterinarians returned from distant farms at midnight, having just completed the day's work.

Several diagnostic tests and laboratory procedures performed by Army veterinarians were new to some local professional groups. These modern techniques were demonstrated and taught to them in order that the work might go on after the

occupation had ceased. Methods of inoculation, tuberculin testing, and agglutination tests were demonstrated. The farmer who was having trouble with his livestock welcomed such assistance. He has few facilities but he uses them to the best advantage. His appreciation was exceptional. He would insist that the veterinarian come into his house for coffee and cakes and disappointment appeared in his countenance when told that the next farmer with his livestock was waiting for us. Such hospitality made this work a pleasure. Acquaintances grew, and it was not uncommon to meet several farmer friends during trips to other parts of the island.

Biologicals, including antigens, vaccine for experimental purposes, and virus and serum used for the control of hog cholera, were prepared at the laboratory. Most important to the Icelander was the study of diseases in sheep. A condition found in the lungs of sheep known as jagziekte, is characterized by adenomatosis of the lungs. Little is known of the cause, methods of transmission, and control. A similar condition has been encountered in South Africa and in parts of Montana. Recently it is said to have been reported by a physician as having been found in human beings.

Paratuberculosis was a most serious disease in local flocks. Quarantine and testing supplemented with slaughter had been tried. The variation in results using different lots of johnin imported from England was rather discouraging. With johnin prepared in the veterinary laboratory and also imported from the United States, another controlled experiment is to be tried.

Abortion appeared in some of the flocks of sheep with losses at times ranging from 30 to 50 percent. This condition seemed to appear in cycles of from three to five years. On a small experimental farm near Reykjavik, the limited facilities present were made available to the Army veterinarians. This additional equipment provided means of doing controlled experiments. A vaccine was prepared for experimental use.

Iceland had six veterinarians until the fall of 1942 when the Government veterinarian died. Some of them had studied in Denmark and several in Germany. Army veterinarians accompanied and advised native practitioners. When one of them, who was a member of parliament, went to Reykjavik to sit as M. P., the Army veterinarian in this district took care of emergency cases during his absence.

The raising of pigs is a new activity which has been encouraged by the presence of garbage from U. S. Army messes. The growth of this occupation has been rapid. The market price of pork varied from sixty to eighty cents a pound. Pork, however, is as yet used mostly by those Icelanders who have traveled abroad.

At the request of the Icelandic Government, Americans gave advice on the control and treatment of diseases of pigs. In the summer of 1942, an outbreak of hog cholera spread rapidly. Serum was brought in by airplane from the United States, virus was prepared, and Army veterinarians, during the initial steps, inoculated exposed animals. This epidemic received so much publicity and was taken care of so quickly and efficiently that an Icelandic magazine humorously suggested that the veterinarians might be able to find a tonic for the political troubles of Iceland.

Echinococcosis in sheep at one time was a serious disease, but very little is present now. Braxy is effectively controlled by a vaccine prepared at the laboratory of the Medical School. Pasteurellosis is sporadic in its appearance.

No serious diseases are present in dairy cattle. A few cases of milk fever are present from time to time. A single epizootic of an enteric nature appeared in the spring of 1942. Three cases of anthrax were encountered. Aid and advice were given in disinfecting the farms involved and in disposal of the carcasses. The dairy cattle of Iceland resemble the Holstein, Guernsey, Jersey, and Shorthorn.

The Icelandic ponies are not troubled with disease. In a few animals during the winter months one finds a fungus-like condition within the extremely long winter coats. The Icelandic dog, which is small in stature is found almost entirely on the farms, where it is used for such duties as caring for sheep. High taxes limit the number of dogs in towns. Restrictions on dogs were originally inaugurated to help control echinococcosis. During recent years, distemper has killed a large number of dogs.

Iceland does not have many chickens, although near Reykjavik there are several poultry ranches. The chickens are usually housed in the cattle barn above the animals at one end of the building. A few flocks have conditions present that are similar to vitamin deficiency diseases in the United States.

The veterinary section, in order to get information to the people on modern methods of milk production, together with

suggestions on the care and treatment of livestock, prepared newspaper articles which were published in all Icelandic papers. An illustrated booklet also was prepared by Army veterinarians, printed in Icelandic and distributed to the farmers, libraries, schools, and universities. This publication included detailed instructions on the production of safe milk, principles of disease control, and information on modern methods of animal husbandry. The booklet also contained information with respect to swine production.

Photoroentgen Technique

Employing Optimum Kv.P. Principles

MAJOR ARTHUR W. FUCHS
Sanitary Corps, Army of the United States

Although the Army has provided excellent equipment for photoroentgenography, there is evidence that technicians have not been fully aware of certain processing rules and have unnecessarily operated the x-ray apparatus and tubes at peak capacity. To correct existing faults, the optimum kilovoltage technique is recommended. This technique is based on the premise that for every radiographic projection there is an optimum kilovoltage that will penetrate a given part with the production of a minimum of secondary radiation fog—assuming that proper measures are taken to control the amount of secondary radiation reaching the film. Its use depends on the classification of all body parts into three groups that serve to facilitate the use of the time factors in convenient multiples. Details of this technique have been published.[1] A working description of its application to photoroentgenography follows:

Apparatus

X-ray apparatus with a capacity of 100 Kv.P. at 150 Ma. must be employed for the technique. A stationary anode x-ray tube with a focal spot of 5.2 mm. is required, although the technique is applicable with rotating anode tubes. A blower attached to the tube head is advisable, although unnecessary,

1. Fuchs, A. W.: The Optimum Kilovoltage Technique in Military Roentgenography, Am. J. Roentg., 50:358, September 1943.

for the heat generated by the sequence of exposures is well within the safe heat capacity of the tube.

Some photoroentgen laboratories are equipped with apparatus possessing a capacity of 85 Kv.P. at 200 Ma. Such generators may be satisfactorily altered to deliver 150 Ma. at 100 Kv.P. by the addition of an auxiliary piece of equipment.

Kilovoltage

The transparent image produced by a kilovoltage of 100 assures visualization of all required thoracic structures since complete penetration is achieved. The contrast scale is also sufficiently long that extreme latitude in exposure and good visualization of detail are possible. This kilovoltage causes production of a large amount of secondary radiation, but the efficiency of the grid supplied with the photoroentgen camera is sufficiently great to dispose of it before it reaches the fluorescent screen.

Milliamperage

It is unwise to operate photoroentgen apparatus at its capacity of 200 Ma., for the toll in damaged apparatus may be great. Operation of x-ray tubes at their capacity results in destroyed tubes. Some laboratories dropped to the use of 150 Ma. resulting in an immediate economy in the life of tubes and making possible more than 100,000 exposures from them. A milliamperage of 150 has been established, therefore, as a standard.

Tube Position

The long axis of the x-ray tube should be vertical with the cathode end uppermost, making it possible to take advantage of the "heel effect" of the anode. In this position, the greatest x-ray intensity is directed toward the upper thorax where the greatest tissue density exists. Also, better dissipation of heat from the tube is effected for the oil heated by the anode rises, causing more efficient circulation. The vertically placed tube must be centered properly, for the relatively short anode-screen distance of 36 inches may cause cutoff of the image when stereoradiography is performed. The tube should first be centered, then the No. 1 stereo-shift made and, after exposure, the No. 2 shift. The No. 1 stereo-shift tube position should not be employed for centering, because cutoff of the image results. Furthermore, a total stereo-shift of 3 inches only should be employed.

TECHNIQUE

All chests are placed in three anatomical groups according to thickness. The first group includes those chests measuring up to and including 24 cm. and requires 2/10 second's exposure; the second, comprises chests in the 25-27 cm. range and needs 3/10 second; and the third, from 28-32 cm. requires 4/10 second's exposure. All images are transparent and the densities within the areas of the great vessels and heart in each group are comparable; and the lateral borders of the bony thorax are in most instances clearly defined. An exception to the above standardized technique should be made. There are chests in the first and second groups which are wide and the postero-anterior thickness from an absorption standpoint is greater than the group in which they are placed according to actual measurement. These wide chests will require an additional 1/10 second's exposure plus the exposure time assigned to the group. It may be found also in the first and second groups that any film showing insufficient density can be given the required density by repeating the exposure plus 1/10 second.

Images of wide chests also are often cut off at the edges of films. Since wide chests are frequently shallow in postero-anterior thickness, the usual average proportionate relationship between flesh, bone, and airbearing tissue is upset and less airbearing tissue is present. This results in slight underexposure of the film. The peripheral portions of the chest are particularly affected because of the inherent spherical aberration of the present photoroentgen lens. In newer lenses, this aberration has been to some extent corrected. If it is necessary to employ an exposure greater than 4/10 second, a 14- by 17-inch radiograph should be made.

A small fourth group comprising chests 33 cm. and greater in thickness, requires the use of 14- by 17-inch radiography. The percentage of such cases is less than half of 1 percent of all cases and photoroentgenography is not justified from the standpoint of tube conservation.

Since it necessary to pose properly and instruct the patient, no more than one stereo-pair per minute is to be made. Operation should take place for fifty minutes with ten minutes' rest per hour. Based on an eight-hour day, 400 patients can be

examined without undue fatigue by personnel or excessive heating of x-ray tube.

SUMMARY EXPOSURE FACTORS

Constant factors		*Variable factor (time)*	
Kv.P.	100	Thickness	Time
Ma.	150	-24 cm.	2/10 sec.
Distance	36 in.	25-27 cm.	3/10 sec.
Stationary grid		28-32 cm.	4/10 sec.
Time-temperature processing Kodalk developer		33- cm.	Use 14- by 17-in. film exposure.

PROCESSING PROCEDURE

Photoroentgenograms constitute records which are of extreme value to the Government not only at the time they are made but years hence. It is necessary, therefore, that a standardized processing procedure be adopted, so that the basic objectives of photoroentgenography may be served now, as well as in the future.

Film used for photoroentgenography is single-coated, and the emulsion is most sensitive to the blue-violet light emitted by the fluoroscopic screen mounted in the photoroentgen camera. The characteristics of the film are such that longer development must be employed than that normally given to x-ray film.

A standardized time-temperature method of development must be employed if the photoroentgenograms are to possess uniform quality. Variation in time of development produces variations in image density which influences the diagnostic appearance of the photoroentgenogram. When the processing procedure is essentially a constant, variations in density may be attributed to anatomical or pathological peculiarities of tissue.

Development

Photoroentgen film requires eight minutes' development at a temperature of 68° F. in fresh Kodalk x-ray developer (Item 1K62320). To insure complete development of the film to an average density, the rate of exhaustion of the developer must be noted. By recording the number of films passed

through the solution, compensation for the decrease in developer action because of its progressive exhaustion is made by changing the development time.

The time of development and the number of 4- by 10-inch films to be processed for given periods of exhaustion of given quantities of solution have been determined by experience and are listed below:

Exhaustion period	Time of development	Number of films (4" x 10") developed in tanks of varying capacity			
	68° F.	6 gal.	10 gal.	15 gal.	20 gal.
A	8 min.	637	1125	1767	2468
B	9 min.	292	518	809	1130
C	10 min.	214	375	589	821

At the end of the "C" period, the developer is discarded and new solution placed in the tank. The fixing bath is also changed.

When the temperature of the solution changes, the development time must also change in order to maintain average film density. The following time-temperature table should be employed to effect the proper change.

Degrees F.	Exhaustion period		
	A	B	C
64	9½ min.	10½ min.	12 min.
66	8½ min.	9½ min.	11 min.
68	8 min.	9 min.	10 min.
70	7½ min.	8½ min.	9 min.
72	6½ min.	7½ min.	8 min.

Fixation

The purposes of fixation of the photoroentgenograms are to remove the unexposed silver bromide crystals from the film, thereby clearing it, and to harden thoroughly the emulsion to facilitate drying. Hardening of the film depends on a reason-

ably active fixing bath. If exhausted fixing baths are used, hardening of the film is eliminated. The emulsion will then remain swollen with solution, and danger of melting in the wash water or a prolonged drying time may result.

To insure procurement of well-hardened and shrunken emulsions, the quantity of fixing bath should be equal to 1½ or 2 times that of the developer, and, each time the developer is changed, the fixing bath should be changed. This procedure will make possible fast drying and eliminate many other troubles encountered with hot weather film processing.

Drying

Adequate film drying facilities have been provided photoroentgen laboratories but film drying frequently is not given sufficient consideration. If the films are placed in the dryer with swollen emulsions, they will not dry rapidly, particularly when the atmospheric humidity of the room is high. Delayed drying is often attributable to recirculation of moisture-laden air in the darkroom, the relative humidity being higher than that of the outside atmosphere. When emulsions are adequately hardened, the drying rate is fairly rapid; whereas if the humidity is high, the drying rate is unduly prolonged.

Elimination of moisture-laden air may be attained by venting all dryers to the outside. Vents may be ducted through the roof or floor of cantonment-type buildings or ventilator ducts contained in other building types.

Many Army laboratories are equipped with commercial-type dryers and suitable ducts can be led from them to a ventilating system or to a window and thence to the exterior. Some stations may have been furnished Item 96055, X-ray Field Unit, Dryer and Loading Bin Combination. To attach a duct to this dryer, it is necessary to secure a new accessory, Item 96056, X-ray Field Unit, Dryer and Loading Bin Combination, Exhaust Duct, Hot Air, which may be easily affixed to the exhaust opening of the dryer for connection to a vent pipe. Dryers are not essential unless large quantities of films are to be processed in a short time. Air-drying is satisfactory and drying speed may be accelerated, if needed, by an ordinary electric fan.

A New Elastic Splint for Wrist Drop

MAJOR FRANK H. MAYFIELD
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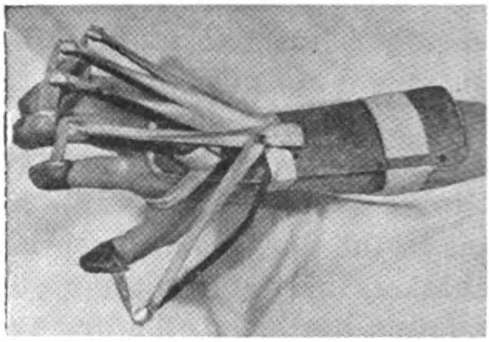
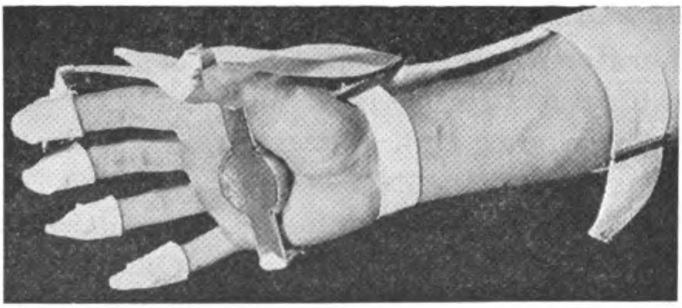
The usual cock-up splint for wrist drop is a rigid structure designed to prevent overstretching of the paralyzed muscles. The splint described here accomplishes this purpose and in addition permits activity of the unparalyzed muscles of the arm. Thus atrophy of the muscles and stiffness of the joints that accompany disuse are prevented.

The plan of the splint is simple, consisting of a posterior shell of light metal padded with felt and bent to support the wrist in the desired degree of extension. It is held in place on the forearm by two circular straps. The fingers are supported in glove tips attached to the splint by elastic bands which run over sliding pulleys supported on metal ribs. A leather pad suspended by elastic is used to support the palm. The elastic bands are arranged so that they reproduce as nearly as possible the normal pull of the extensor tendons.



Dorsal view



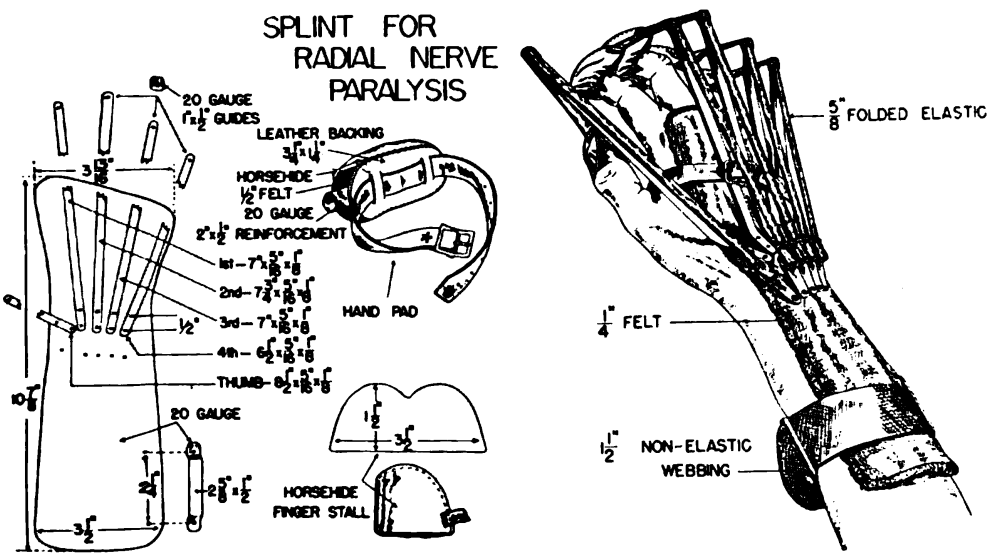
Volar view showing palmar pad

The splint in the form described is the result of much trial and error, and, while satisfactory, it may be improved. Trials were made with anterior splints which served the same purpose, but these were abandoned.

This instrument has been used on all cases of radial nerve paralysis treated in the Percy Jones General Hospital and has been found superior to all other splints which we have used

for this purpose. It also keeps the flexor muscles strong, permitting them to be continuously active. In the event that recovery of function of the muscles supplied by the radial nerve does not take place, tendon transplants would be more effective as the muscles would be stronger. When radial nerve recovery does occur, we feel that a better end result is obtained when this splint has been used continuously. A potential danger in the use of this splint is the tendency of the elastic extension to flatten or overstretch the palmar arch. The palmar pad, if properly fitted, prevents this.

The instrument is light and may be easily manufactured in any brace shop. With slight alterations of the ribs it may



be made to fit patients other than those for whom it was originally designed. It is durable except for the elastic, which requires replacement about every six weeks.

Others have described splints that are similar in principle. No claim of originality is made. This splint is a modification of a device similar in principle used by Dr. Sumner Koch of Chicago. It was developed in the brace shop of the Percy Jones General Hospital at Battle Creek, Michigan.

Evaporation Beds for Kitchen and Shower Waste

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During the present war it became necessary to locate certain Army camps in areas where the soil is a rocklike, impervious clay. This was particularly necessary in certain sections of India. The type of clay soil encountered was so impervious that the usual soakage pits for kitchen and bathroom waste could not be made to function for longer than a week or ten days.

There appeared to be two possible lines of attack which offered some prospects of success. One was to construct open deep wells with the hope of striking a porous strata well below the surface and to discharge wastes into these wells. The other was to develop open, surface evaporation beds and depend on evaporation plus percolation. At a certain cantonment more than fifty of the deep wells were constructed, from 6 to 10 feet in diameter and about 60 to 90 feet deep. Construction was very difficult and much blasting was necessary to break up the stonelike clay. These wells did not solve the problem of kitchen or bath waste disposal, as their percolation capacity was small and the least solid or greasy materials rendered them useless. They were extremely difficult to clean when they became clogged. In an attempt to develop further this disposal system, one well was carried down to a depth of 110 feet; yet no more suitable stratum was found.

These wells were expensive to construct; they were a source of danger to the men and to animals; the question of contamination of usable underground water supplies arose; and, as they filled, a serious mosquito nuisance developed in areas otherwise nonproductive of mosquitoes.

The use of evaporation beds was suggested at one of these difficult areas by Mr. Wright of the Public Health Service Medical Mission. He and his associates experimented with these, and it was determined that they would be satisfactory

for kitchen and bath waste if an area of 3 square feet was allowed per person for kitchen waste and 2 square feet per person for bath waste. It was convenient to construct these beds in individual units, 8 feet by 10 feet in size, and to make as many of these units as might be necessary to care for the contributing personnel. The group of beds was so placed that the waste could be directed to any particular bed as required. The beds were constructed by scraping off the topsoil and constructing a small dyke around the 8- by 10-foot space. The bed itself was then spaded to a depth of 10 to 15 inches and the surface raked into a series of ridges and depressions, the height of the ridges being about 6 inches above the depressions. These rows of ridges were formed lengthwise or crosswise of the bed as might seem desirable.

In operation, a bed was flooded one day to the top of the ridges and the water allowed to evaporate and percolate for two days. A day or so later the bed was usually dry and ready for re-spading and re-forming. The other beds in the series were flooded on successive days and the same sequence of events brought about. Thus the cycle for each bed was: flooded one day, idle two days drying, re-spaded on the fourth or fifth day, and ready for another flooding.

Where a mess hall handled 200 men a day, it was convenient to construct a series of seven beds, one for each day of the week, and label each bed as to the day it was to be filled. Careful attention was given to see that a proper rotation of beds was maintained and that they were kept in proper condition. It was also absolutely necessary that an efficient grease trap be used ahead of the evaporation beds in order to prevent clogging of the beds.

Evaporation beds for bath waste were handled in a similar manner, allowing 2 square feet of bed area per person. Evaporation beds, if properly handled, were inoffensive; water disappeared by the end of the third or fourth day; and they did not produce mosquitoes. The beds, although known as evaporation beds, operated by evaporation, by percolation, and as an oxidizing medium for the waste.

Beds constructed and handled as described above proved very satisfactory and became a standardized method of handling kitchen and bath waste in a hot, dry climate where the type of soil rendered the soakage pit impossible to operate.

Dentistry in the German Army

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A dental survey was made at a camp in Illinois, of 1,100 German prisoners who had been captured in North Africa. All of them were enlisted men. Of this group 86 percent had received dental treatment in the German Army; 14 percent had either been in good dental health when surveyed by their dental personnel or had avoided the dental service. It was found that about 4 percent of latter group required extensive dental treatment such as extractions, fillings, and prosthetic appliances.

Dental treatment in the German Army, the prisoners said, was optional; however, each soldier was urged to have necessary work done, and examinations were made occasionally to see if the work had been done. These men had been sent to North Africa late in 1942, when the Afrika Korps was no longer a "picked-man" unit. Some men requiring dentures said that impressions had been taken in North Africa, but they had been transferred to another location before the appliances could be inserted. A man entering the German Army is given a complete physical examination. In some cases the dental work may be done by a civilian with a recommendation from the Army as to type of treatment indicated and the cost is borne by the government in accordance with a previously established fee.

This dental survey showed that about 33 percent of the Germans needed two or more extractions. Most of the prisoners were reluctant to submit to the necessary dental treatment, preferring to wait until toothache developed. About 22 percent of the men required emergency fillings; another 2 percent did not have a sufficient number of teeth to masticate the Army ration, or had lost or broken their dentures; 57 percent of the prisoners required emergency treatment such as extractions, fillings, or dentures; 31 percent needed routine fillings, while another 2 percent were listed as in need of partial dentures.

There were only 9 percent of the individuals who did not need some treatment.

A synthetic type of filling material, commonly used in posterior teeth and similar to the silicate cements used in this country, was found in more than 650 fillings. This material seemed much harder and more resistant to crushing forces than the silicate cements; however, the filling was extremely weak at the margins or wherever shearing stresses were encountered. The majority of these fillings had faulty margins with extensive recurrent decay and many had devitalized pulps with periapical abscesses. Cement bases were not used under any of these restorations regardless of the depth of the cavity.

About 400 of the 650 synthetic type fillings were done by civilian dentists. The remainder were inserted by dental officers in combat zones. In only two cases had amalgam been recently employed, and these fillings were inserted for the prisoners by British dental officers in Algiers. However, a larger number of amalgam restorations had been placed before the German shortage of amalgam developed, which according to a former German dentist was in 1940.

Only 25 partial dentures and 7 full dentures were seen during this survey. Twenty-two of these dentures were made of acrylic, the majority of which were made in Italy and North Africa. The vulcanite dentures, all made by civilian dentists, were unusual; they were a combination of Wipla metal in the palatal area with vulcanite flanges. Rubber suction cups were used in the plate of two full dentures. One of the prisoners had lost the cup in his full denture. Wipla metal was also used in the palatal area and incorporated in the flanges with retention clasps in the vulcanite partial dentures. The lingual bars in lower partial dentures were made of vulcanite or acrylic. The clasps used were of a fine-gage, wrought stainless steel wire. Occlusal rests were not constructed in any of the partials. Two of the vulcanite partials were retained by a vulcanite bar with no clasps, while four partials had a band-type circumferential clasp. Defective abutments, broken clasps, and warpage resulted in the nonserviceability of all the partial dentures made of vulcanite, while warpage was present in cases where Wipla metal was used.

Stainless steel is used almost exclusively for crown and bridge work and all large military installations, including mobile units, have special laboratory facilities for using this material. Among these 1,100 German prisoners 58 had stain-

less steel bridges, the majority of which were made in North Africa and Italy. These bridges, generally well constructed, consisted chiefly of full cast crown abutments with a wide use of the suspended pontic. They retained a high luster and were resistant to corrosion. The cast steel full crowns usually made by civilian dentists are extensively used for restoring individual teeth.

Two bridges made by civilian dentists were of special interest, the one a complete acrylic bridge with jacket crown abutments from the right cuspid to the left central incisor, and the other an all-acrylic cantilever type replacing the upper right lateral incisor, which was suspended from a jacket crown on the right central incisor. The two bridges were massive from an esthetic point of view but they were quite serviceable.

Three men also had porcelain jacket crowns made by civilian dentists, all of which were well constructed and pleasing in appearance. One of the men had porcelain jackets on all of his upper incisor teeth.

The incidence of Vincent's stomatitis has been surprisingly low in this group at Camp —— with only 10 cases and these have not been typical. The infection usually has been superimposed on a traumatic gingivitis caused by subgingival concretions and then generally on one side of the mouth. Although the mouth hygiene of the average German prisoner is good, these cases of Vincent's infection resulted from improper care of the mouth.

Most of these men have been in the German Army for more than four years. Some of them served in the Polish, French, and Russian campaigns and with the Afrika Korps. Troop movements and the universal reluctance of the individual to seek dental treatment even though it is available, resulted in their present dental condition. To date only 22 percent of the prisoners have reported to the dispensary for dental treatment since the survey.

These men revealed that a form of socialized medicine and dentistry exists in Germany and that these professions are heavily subsidized. Generally, the dental work found in examining the prisoners was not comparable to the standard of dentistry afforded our own troops. The fact that cement bases were not employed in deep cavities under fillings, and that in many instances root canals were not treated or filled when there was evidence of devitalization, has led to much dental pain, discomfort, and distrust.

German field equipment is similar to the U. S. Army M. D. Chest No. 60. The dental chest contains a folding chair, a foot engine, and a minimum of essential operating instruments and supplies. The larger fixed installations are more completely equipped. Mobile dental units with laboratory facilities for processing dentures and stainless steel for crown and bridge work are also available.

The prisoners said there is one dental officer for every 800 to 1,000 men in the German Army depending on the type of unit. The two types of practicing dentists in Germany are (1) the "dentist" who is not a doctor of dentistry, and (2) the *Zahnarzt*, who has the title of doctor and must be a graduate of a gymnasium (equivalent to our high school), have two years of college, and must be a graduate of an approved class "A" dental college. The "dentist" graduates from a dental technical school; however, he is allowed to do all types of restorative work as well as extractions. The "dentist" is not eligible for a commission in the Army and when inducted must serve in any branch to which assigned. The *Zahnarzt* who can become a commissioned officer is first taken into the Army as a private, where he receives basic military training for several months. He is rapidly promoted through the ranks as a noncommissioned officer, and on the completion of his basic training is ready for officers' training school. He is called an *Unterarzt* during the period prior to receiving his commission, and is permitted to carry on his professional duties as a dentist. When commissioned he is called an *Assistentsarzt*, or assistant surgeon, a designation equivalent to second lieutenant in the United States Army. His status and eligibility for promotion is the same as the medical officer, who receives the same preliminary training before being granted a commission.

The Importance of Dengue Fever. Dengue fever can be crippling to a nation's war effort in the field and on the home front, so that it becomes nationally important, both in civilian and military life. . . . It is a singular circumstance that dengue fever is not medically well known. This is not the fault of the individual practitioner, but is principally due to the facts that relatively few have to deal with the disease and that literature on dengue fever is largely buried in journals inaccessible outside large libraries.—Lumley, George F.: Dengue. Service Publication, School of Public Health and Tropical Medicine, University of Sydney, April 9, 1943. (No. 3, p. 9).

Apparatus

ADAPTATION OF STANDARD FIELD X-RAY UNITS FOR LAMINOGRAPHY

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A number of attachments have been devised for standard radiographic machines which produce good body section roentgenograms. Examples of these are the attachments described by Twining[1] and Alexander.[2] Standard Army field x-ray units[3,4] also can be adapted readily for laminography. The accessories required for the apparatus can be made by a mechanic from materials which are easily available.

Description of apparatus

Essentially, the apparatus consists of two Army field table units which are placed one above the other (figure 1); a wooden cradle (figure 2) attached to the horizontal carriage of the upper table to accommodate the x-ray tube of a standard field unit, and a rigid lever passing from the wooden cradle to the horizontal carriage of the lower table. This is connected to an adjustable fulcrum (A in figure 3) in such a way that the tube and horizontal carriage in the lower table maintain a constant relationship to each other as they move synchronously in opposite directions.

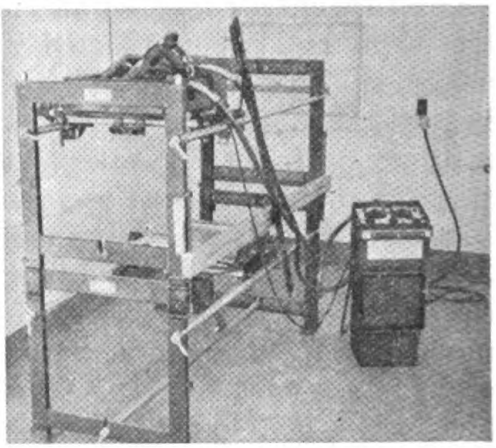

FIGURE 1. Field table laminograph. One field table is placed above the other. The hollow legs of the upper table fit securely over the knobs on the top of the fabricated end piece of the lower table.

The upper table is assembled without the wafer grid and C-shaped supporting member (figure 1). The lower table is similarly assembled except that the wafer grid is mounted in position. The hollow legs of the upper table will fit securely over the knobs on the top of the fabricated end pieces of the lower table.

The wooden cradle (figures 2 and 3) consists of two frames one within the other. It is adjusted so that the inner frame on which the tube rests can rotate on bolts located on each side. Suitable notches cut in the lower margin of the outer frame fix it firmly to the transverse rods of the horizontal carriage.

An adjustable fulcrum is provided by attaching a slotted wooden bar (B) to the legs of the upper table by means of long bolts which are an integral part of the table. Set screws (C) hold this bar at any predeter-

1. Twining, E. W.: Tomography by Means of Simple Attachment to Potter-Bucky Couch, Brit. J. Radiol., 10:332, 1937.
2. Alexander, G. H.: Simple and Inexpensive Tomographic Method, Am. J. Roentg., 39:956-958, June 1938.
3. Military Roentgenology, War Department Technical Manual (TM 8-275). Washington: U. S. Government Printing Office, 1942.
4. Lorimier, A. A.: Wartime Military Roentgenology, Radiology, 36:391-403, April 1941.

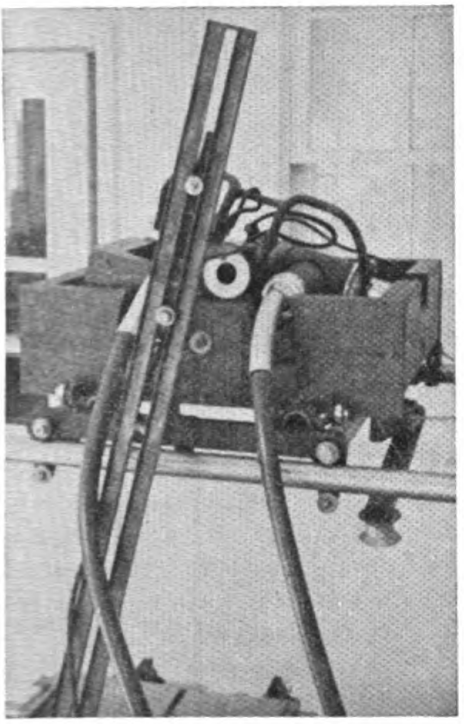

FIGURE 2. Wooden cradle assembly of field table laminography showing the x-ray tube in position on the inner rotating frame.

mined level. Motion is imparted to the tube assembly carriage by a weight-pulley cable arrangement (D). This is transmitted to the slotted lever (H) by means of a sliding bearing and bracket (E) attached to the horizontal carriage supporting the wooden cradle. (F) tilts the tube in such a way that the target is always directed to the center of the film. A third bracket (G) is attached to the grid carriage of the lower table. This is fitted into the slot of the lever with a sliding bearing below the fulcrum. The field table was originally designed for use with an Army litter. More accurate and consistent results will be obtained if this is replaced with a wooden table top of clear lumber.

All components of both the mobile x-ray unit and the field tables are left intact, available on a moment's notice for conversion for routine radiography. The accessories were clamped in place or fitted into holes or anchorages already a part of the apparatus.

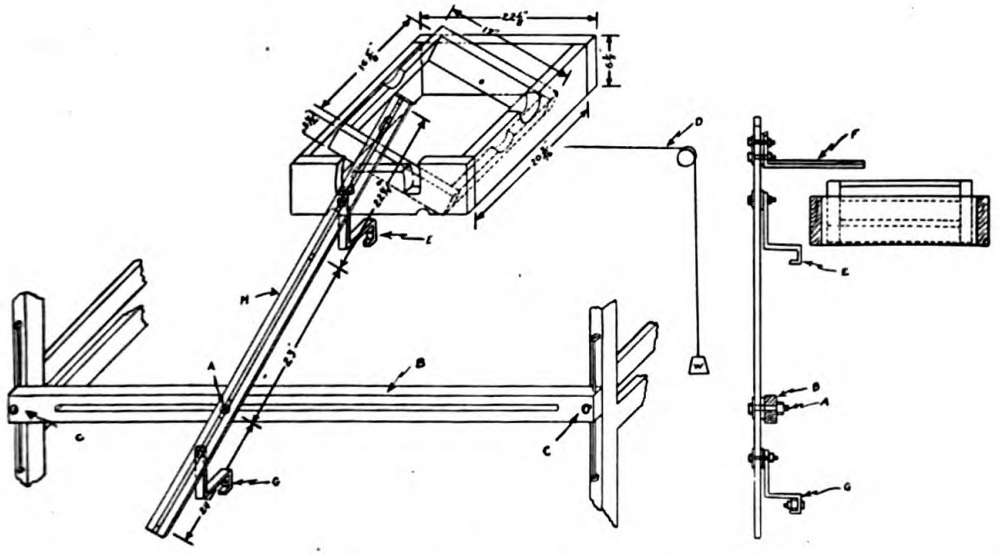

FIGURE 3. Scale drawing of field table laminograph. (A) Adjustable fulcrum; (B) slotted wooden bar; (C) set screw; (D) weight and pulley arrangement; (E) bracket for power transmission to lever attached to horizontal carriage; (F) rocker arm attached to x-ray tube; (G) bracket attached to horizontal carriage of lower table for transmission of power from lever (H) to Bucky carriage.

TABLE I
Technique chart

	Measurements in cm.	Kv. P.	Ma.	Time in seconds
Chest (A-P)	22	66	30	4
	23	68	30	4
	24	70	30	4
Larynx (A-P)	11	70	30	4
	12	72	30	4
	13	74	30	4
Femur-tibia (A-P and lat.)	16	64	30	4
	17	66	30	4
	18	68	30	4
Tibia (A-P)	9	56	30	4
	10	58	30	4
	11	60	30	4

Operation of laminograph

Examples of the exposure factors used in operation of the laminograph are shown in table 1. Experience has shown that an exposure time of four seconds serves best for the field table laminograph. This speed can be obtained by adjusting the weights attached to the pulley cord. The fulcrum (A) is then adjusted to the desired level with the lever (H) in a vertical position. The upper horizontal carriage is then drawn back to the head of the table and held with one hand. It is then released. As soon as it starts to move, the exposure is begun and should end just before the motion of the carriage is stopped by the end piece of the table.

SEMINARS AT ARMY MEDICAL MUSEUM

The Army Medical Museum, Washington, D. C., conducts a seminar each Saturday afternoon. The meeting on 11 December 1943 was addressed by Dr. Harry Goldblatt, Professor of Experimental Pathology, Western Reserve University, Cleveland, Ohio, on "Dietary Factors in Experimental Liver Damage." Dr. Goldblatt at that time was Resident Consultant in Pathology at the Museum. The 4 December seminar was addressed by Dr. Milton Helpern, Deputy Chief Medical Examiner, New York City, on "The Pathology of Estivo-Autumnal Malaria in Drug Addicts."

Staff conferences also are held daily at the Army Medical Museum from 1 to 2 p.m., at which pathologic material offering diagnostic problems or having particular interest is discussed and histologic slides projected on a screen. On Wednesday, the conference hour is given over to other departments of the Army Medical Museum. The Photographic Service may, for example, show illustrations received from overseas theaters.

All medical officers stationed in Washington and vicinity are invited to attend the staff conferences and seminars.

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Carlisle Barracks, Pa., 1-4-44—60,000